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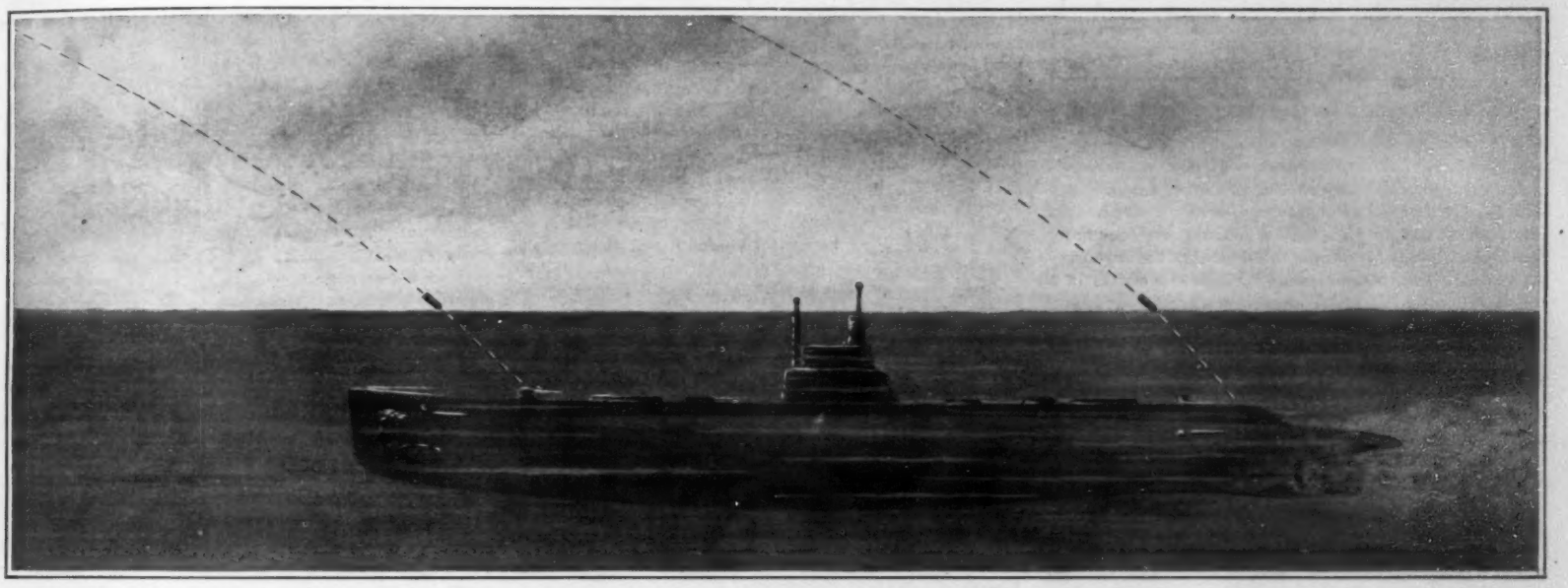


The danger space with the ordinary shell, under conditions shown in this sketch, is limited to the exposed periscopes; with the new diving shell (non-ricocheting), the danger space is equal to the whole length of the ship

Shells That Will Dive

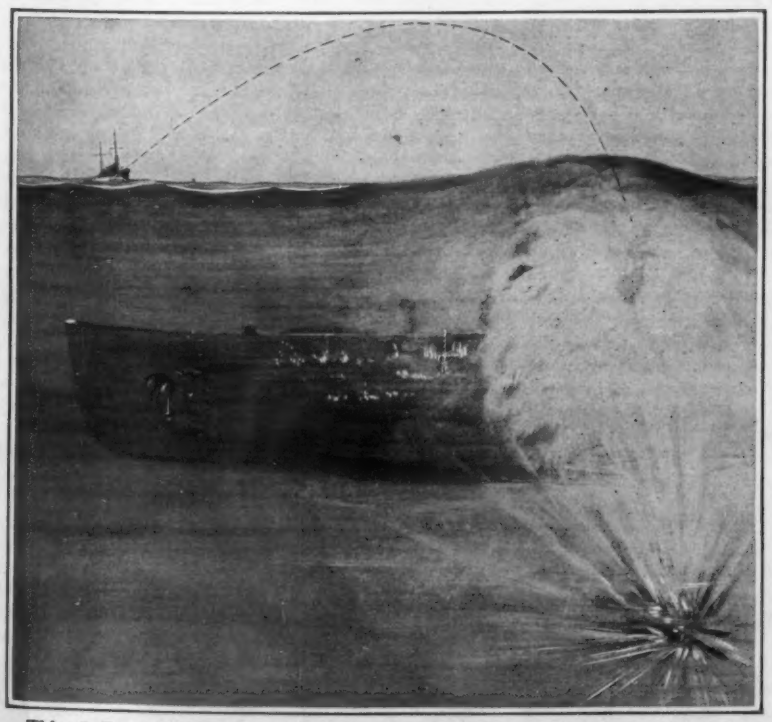
SHELLS which strike fairly smooth water at an angle of less than nine to ten degrees, if they are provided with an ogival head, will fail to "bite" and will ricochet, or bound from its surface into the air. Sometimes the path described by the ricocheting shell will consist of great parabolas, in which case the shell may travel for a straight mile before it again strikes the water. At other times a shell will travel under and near the surface of the water, raising a line of numerous small geyser effects. The ricochet trajectory depends upon the range and velocity of the shell and the condition of the sea.

For these reasons, much attention has been paid to the problem of devising a shell which, instead of rebounding from the surface, will "bite" the water on striking, and continue its course below the surface. A recent dispatch from Washington states that the problem has been solved and that our ships are provided, or soon will be, with a shell which will dive and strike a submarine, or burst in its vicinity, even though the enemy be below the surface. The shape of the shell cannot, of course, be disclosed at this time. In order to show how valuable is this development, our artist has drawn the accompanying sketches which demonstrate very clearly its military value.

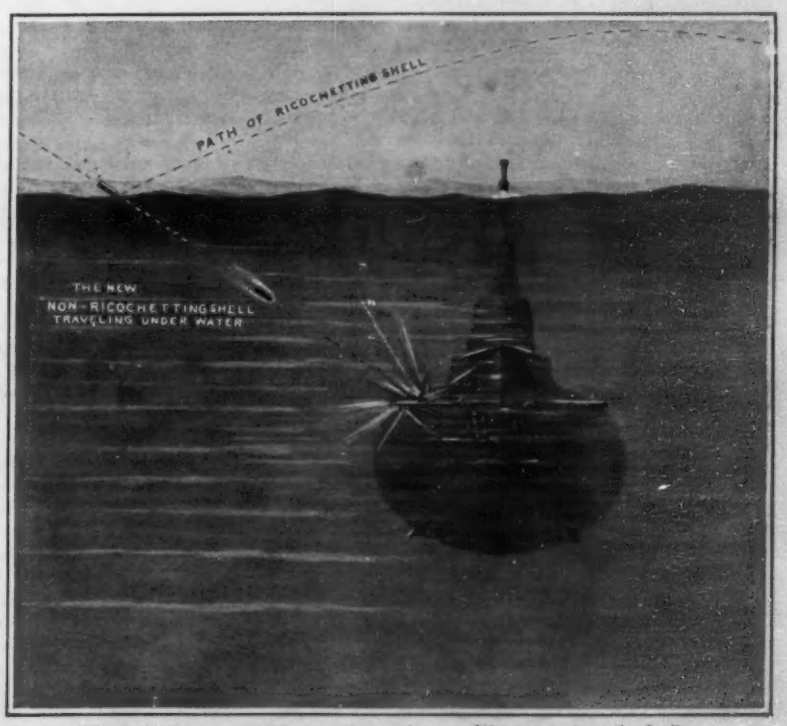
The periscope is an exceedingly difficult object to hit, and a hit, at any considerable range, even by a first-class pointer, would be a matter more of luck than good shooting. But if the shells are of the diving type it is evident that, by dropping them a little short of the periscope, they would have a fair chance to strike the body of the submarine itself. This is true, even if the line of fire were normal, or approximately normal, to the longitudinal axis of the submarine; but, as another of our drawings shows, the chances of scoring a hit when the submerged submarine was end on to the attacking gun, would be very favorable, since the danger space would be equal to that of the length of the boat, or say one hundred and fifty to two hundred and fifty feet.

Another advantage of the diving shell is that it can be adjusted so as to detonate when it has penetrated the water to any determined depth. In this case, of course, the action would be similar to that of the depth bomb, which has proved a most effective anti-U-boat weapon.

Thus, by the development of this device, one more peril has been added to the many which surround the under-water sea pirates. What with depth bombs, diving shells, enemy submarines below the water, enemy destroyers and patrol boats on the surface, enemy rapid fire guns on the merchant ships, blimps and seaplanes in the air above the sea, and, most important of all, detectors of constantly increasing range and accuracy—well, the U-boat crews, to say the least, are not having a very happy time of it these days.



This shell, with fuse set for depth, has passed over the submarine, and bursting below, has wrecked it by shock transmitted through the water



This shell has passed below the surface and burst against the hull of the submarine

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Can Shell-Scarred Battlefields Be Cultivated?

THERE is a widespread belief that the areas over which the great battles of the trench-and-artillery warfare of the present struggle have been fought, are so completely torn up by shell fire that they cannot be brought under cultivation for many decades, and, possibly, never. Therefore, it is encouraging to learn from an American farmer who writes in a recent issue of *Land and Water*, after a careful study, on the ground, of the battlefields themselves, that not only can these lands be recovered, but there are sound reasons to believe that they will be very fruitful.

The belief that the agricultural lands that have been devastated by shell fire will never again witness the toil and fruitage of seed-time and harvest is based upon three propositions, each of which this agricultural expert believes to be not well founded—and his belief, it should be remembered, is based upon careful exploration of four of the regions most bitterly fought over on the western front: Flanders, the Somme, the Champagne and Verdun.

The theory of the permanent ruination of the soil has been based upon three assumptions: first, that it is so thoroughly "poisoned" by the fumes of asphyxiating gases and high explosives as to render it unable to support any kind of plant life; second, that the deep plowing up by exploding shells has obliterated the fruitful surface soil; and thirdly, that the ground is so completely pitted by deep shell holes as to render the use of ordinary farm instruments—plows, cultivators and tractors, etc.—impracticable.

On the question of the permanent poisoning of the soil, this American farmer states that while the fumes naturally bleach the fresh grass and cause foliage to wilt and die down, the effects last usually only a few days and rarely more than a week or two. If the roots are injured, it is due to their being torn up by explosions and not to the fumes. Says he, "No sooner had I traversed a mile of the first of the four battlegrounds than I had all the evidence I needed to convince me of the utter nonsense (to use the expression of a French official) of the contentions of the learned theorists who have so lightly condemned these blood-hallowed fields to half a century or so of wilderness. Never, under the hands of the husbandman have the fields of northern France brought forth such a wealth of verdure as this last summer. Trenches, used and disused, were clothed to their parapets with a dozen kinds of rank vegetation, and the only shell holes which were not half submerged in greenery were those which had been formed within the month."

As to the destructive effect of the upheaval of the non-humus-bearing soil from below, this observer states that for every pound of this underlying chalk, or whatever it might happen to be, thrown up by a shell from the apex of its crater, a far larger quantity of earth, rich in decaying vegetable matter, is scattered from the frustum of the cone which is torn out nearer the surface. He likens this shell action to the American farmers' practice of cracking up the underlying hard-pan with dynamite, and giving the starved roots a chance to penetrate to the moisture-laden levels below.

Evidently this practical farmer, who surely should speak with authority, would have us believe that ultimately the shell fire will have a positively beneficial effect upon the supposedly worthless battle lands of France and Flanders. Thus, he writes: "I saw where the seeds of petunias, snap-dragons and nasturtiums of a little old-fashioned garden, which had been turned over dozens of times by bursting shells, had sprouted, grown, and were flowering as I have rarely seen any of their kind now or before, even under the hands of a gardener." Many times in the course of his explorations, he walked head-high through patches of "volunteer" oats and wheat and barley, that would undoubtedly have dwarfed the carefully manured and tended crops that grew there three years previously. And once, growing from the bottom of a "Jack Johnson" shell hole he saw a towering clump of Indian corn.

The third problem, that of getting the ground so far levelled off as to permit the use of the farm tractor and plow, is being solved to no little degree by nature. The erosive action of the elements—snow, wind and rain—is already smoothing out the irregularities. Blown dust, and rain-washed silt will deposit a foot of earth a year in the bottom of an ordinary shell hole. In the fourteen months since the great mine crater at Pozieres was formed, it has been filled in to a depth of many feet by the sluicing down of its sides under the torrential rains.

The first sight of these blown-up areas is, of course, appalling; but the problem does not seem quite so hopeless after one has seen a portion of "cleaned-up" field—one which has been picked over for wire, shells, trench material, rifles and all the rest of the flotsam and jetsam of battle. A Canadian officer, a chance acquaintance during this exploration, who was himself the owner of a western ranch, stated that the danger from unexploded shells was practically negligible. The reason is that a detonator that has failed to go off at the end of a five- or ten-mile flight is not likely to be disturbed by a prod from a plowshare; also there is a steady deterioration of a shell which is buried in the damp earth. Barbed wire can be picked up, and such as is not removed by the first plowing, can be cut off far enough down to prevent its fouling the plow again. Railroad iron, concrete fragments, corrugated steel roofing, have to be gathered together and carted away bodily.

The most puzzling problem is to determine what kind of a machine must be used to smooth out the ground sufficiently to allow the use of farm implements. "The ordinary type of side-wheel tractor would not progress its own length over an average stretch of crater ground and the most powerful caterpillar would stall down at the first big shell hole." It is the opinion of this expert that a machine must be found which can drive straight across such obstacles, dragging the scrapers or shovels after it; and he thinks that on the battlefields themselves is to be found the answer to the question as to what must be done with the thousands of tanks that will be left without occupation at the end of the war. We are inclined entirely to agree with this American farmer that the tanks would make admirable tractors for drawing specially designed plows or harrows in the first rough cultivation of these shell-scarred lands.

The Nursing Place of Industrial Evolution

FROM time to time we have referred, in these columns, to the inadequate force and equipment of the United State Patent Office, hoping thereby to focus attention upon it and bring about a betterment of conditions. These conditions are undoubtedly due to lack of appreciation on the part of the public. When the wave of public and Governmental interest in industrial matters swept over this country at the outbreak of the European War, we hoped that the Patent Office also would profit owing to its intimate connection with the development of applied science. It is "the nursing place of industrial evolution" as Assistant Commissioner Clay put it in a recent paper read before the Examining Board of the United States Patent Office.

This paper entitled "Some Reforms in the Patent System" is published in full in the current SUPPLEMENT. It points out some of the limitations under which the work of the Office has to be done. There is no foreign patent office so burdened. The United States Patent Office has to handle twice as much work as any other patent office and one-third more than that of the whole of the British Empire. Seventy thousand applications for patents are examined in a year's time, and each one of these must be compared against three million previously granted patents. Over forty thousand patents are issued annually and over a thousand interference contests are conducted and decided. And all this work is carried on by a force of but four hundred men.

With the increase of activity in industrial fields there will be a corresponding increase in the labors of the Patent Office; and realizing that something must be done promptly, an earnest effort is now being made to study the situation and improve the facilities of the Office and the nature of the work. In the charter of the National Academy of Sciences there is provision that the Academy shall investigate, examine and report upon any subject of science or art when called upon by any department of the Government. In order to bring about an effective coöperation between the Academy and the various Governmental organizations the Academy has organized, at the request of the President, a National Research Council. This Council has recently been called upon by Secretary Lane and Commissioner Newton for advice and assistance. In response to the appeal a committee has been formed to determine the needs of the Patent Office and suggest improvements. Among the questions that the National Research Council will have to consider are the following:

Can assistance be obtained in the work of reclassifying patents and literature relating thereto?

Can the examiners be encouraged to become specialists in one or another branch of applied science?

Can the gains against dilatory prosecution made under the efforts of former Commissioner Ewing be rendered secure for the future; for instance, by dating the terms of patent monopolies from the date of filing?

Could any adjustment of extra fees for extra claims create an incentive on the part of attorneys to reduce the number of claims so that they will bear more directly upon the "meat" of the invention?

Can the salaries be made attractive enough to keep able men in the service for a longer average term?

Could the establishment in Washington of some institution such as the proposed Institute for the History of Science, aid materially by assembling permanent exhibits, generally illustrative of advances in the various arts, with a corresponding assembling and arrangement of pertinent literature from all the world?

It is true that for the time being public interest has been diverted from the development of the industries by our active participation in the war, but when peace is finally declared there is sure to be a revival of industrial activity on an unprecedented scale. While just now any material improvement in the equipment of the Patent Office may not be expected, now is the time to study the situation and prepare for the activity that is to come.

The Story of the Grayfish

THE aridity supposed to be characteristic of Government documents could hardly be expected to prevail in the aqueous domain of the Bureau of Fisheries. Certainly it does not prevail in the annual administrative reports of that institution, each of which perpetuates, in an age of canneries and steam trawlers, the Waltonian spirit of anecdote, and can be safely commended to palates surfeited with war-front chitchat.

How old Izaak would have loved diverting Venator with the story of the grayfish! From time to time we have mentioned the romantic undertakings of the Bureau with respect to this creature—as well as its fellow-novelties, the tilefish, the sablefish, the burbot and the bowfin. The annual report for 1917, furnishes fresh details, and enables us to round out a narrative that deserves to rank high in piscatorial history.

Only the other day the spiny dogfish was a thorn (or spine) in the flesh of fishermen. His reputation was so bad that when the Government experts first talked of converting him from a nuisance into an asset they were met with a chorus of ridicule and a considerable amount of active hostility. The first step in overcoming opposition to their plans was a psychological expedient familiar to the promoters of dramas, drugs and dry goods; viz., a change of name.

"The species," says Dr. Smith, "has been generally known as dogfish, a name which is objectionable because of the prejudice against it, and is not distinctive because it is shared by various other little-regarded marine and freshwater fishes. People in all parts of the country will eat catfish, but are opposed to dogfish. The name adopted was grayfish, which is descriptive, not preoccupied, and altogether unobjectionable."

In the summer of 1916 a number of canners in Maine and Massachusetts had been persuaded to undertake an experimental packing of grayfish. The Bureau made an arrangement in accordance with which the fish was to be prepared in a stipulated manner and sold at a price not to exceed a certain low figure, in return for which the label was permitted to state that the fish was packed by recommendation of the Bureau of Fisheries.

The prejudice of fishermen against this fish, so long regarded as an unmitigated pest, was not easily dissipated. Only with the greatest difficulty could they be induced even to bring in the specimens caught incidentally, in connection with other fisheries. Money talks, however, and by the end of the fishing season of 1916 New England fishermen were actually going out especially to catch grayfish. The net result of the first year's campaign was the addition to the national dietary of one of the best canned products on the market and one of the most economical of foods to the consumer.

While the season for taking this fish in the East is limited, it may be caught in both summer and winter in the Puget Sound region. Here the salmon canneries are idle in winter, and the canners took kindly to the idea of packing a fish available at that season. "The entire prospective pack of the first concern was contracted for, and it was stated that one packer had been obliged to refuse an order of 20,000 cases on account of the scarcity of cans. "A number of orders for export were received, but were declined by the canners in deference to the Bureau's desire first to satisfy the heavy domestic demand."

To the trade and to the public this fish has been known only since October, 1916, yet as early as last April it was being handled by dealers in 128 towns in New York and Pennsylvania alone, and a month later it was on sale in 30 states and the District of Columbia.

The grayfish, like the tilefish, has fully "arrived." Moreover, there are as good fish in the sea as ever were caught or introduced to our tables by the Bureau of Fisheries, and we look forward to many other exploits of this sort in the future.

Naval and Military

Lookouts in the Submarine Zone.—A recent Admiralty order requires that all British merchant vessels of 2,500 tons gross and upwards shall include in their crew four men, specially engaged, who are to act as lookouts at the mastheads. In the submarine zone, these men are to be employed solely on their special duty, keeping watch in four watches, each to be of not more than two hours' duration. They must obtain a Board of Trade certificate as to their eyesight; and they will receive extra pay whilst in the submarine zone.

A French Big Bertha.—According to a correspondent of the *Washington Post* in France, the French have outbuilt the German big Bertha of 42 centimeters caliber, and their artillery now includes the 52 centimeter mortar. He states that the length of the new gun is such as to render this piece practically a howitzer. The same authority states that one of these pieces was used in the Verdun surprise attack of last August, and also in the Chemin-des-Dames attack in the neighborhood of Laon, where its huge projectiles wrecked the entrances to the quarries and prevented the men inside from reinforcing the first-line troops engaged with the enemy. Two shells from the "52" sufficed to wreck Fort Malmaison.

Development and Instruction in Mine Laying.—Rear Admiral Earle, Chief of the Bureau of Ordnance of the Navy, states in his recent report that an officer of the British Royal Naval Reserve, assigned by the British Admiralty to duty in the Ordnance Bureau, has been of great assistance in adapting the lessons learned during three years of actual sea work with mines to the mines which are now under construction in the United States. The mine force of the fleet has experimented with different modifications of the standard mines and under different conditions. From these trials and from information received from abroad, modifications in the design of our mines have been made, which have increased their efficiency.

A School of War in France.—A recent dispatch states that the greatest school of war the American Army has ever known, and one which, when it is in full swing, will probably be the greatest single school of any army, has begun operations somewhere in France. When the school is in full progress, it will have more than 10,000 students in training. There are in operation schools for trench mortar work, anti-aircraft artillery, anti-aircraft machine gun operations and sanitary work. Out of the school will be turned complete units which will be attached to the different divisions of the army. It includes also an army candidate school for considering non-commissioned officers and examining them as to their fitness for commissions. It is from this school, when the American Army is in full action, that officers will be drawn to replace those fallen in battle.

Rifle Practice at the Camps.—The *Army and Navy Journal* states that a proposition for the popularizing of rifle practice at the different camps has been made to the War Department, which our contemporary considers to have considerable merit. It is proposed to construct at each camp one large centralized indoor range, with the latest equipment for making it possible to use continuously all of the targets. The system proposed would allow of each man having his own target for record or reference. The range would be under the supervision of competent instructors, and every feature of rifle practice, etc., would be taught. Interest would be stimulated by the introduction of inter-organization team matches to be held weekly, with the added inducement of giving prizes to teams and individuals. It is claimed that during the long winter evenings such a rendezvous would appeal to the men, and amusement would be coupled with instruction. The plan originated with a member of the General Staff, and we quite agree with our contemporary that it has many admirable features that recommend it to consideration.

Sixteen Shells a Minute.—The Schneider-Creusot works, the ammunition works where the greatest number of the famous French 75 mm. guns are made, covers a total area of 15,000 acres, 150 of which are used for buildings. To connect the different parts of the big plant 180 miles of railroad track are needed and 65 locomotives and 5,700 cars. A total of 116,000 horsepower is employed in operating the works of which 4,600 horse-power is electric. This plant has 80,000 employees and 4,200 machine tools are in operation. One of these is 160 feet long. Outside the Schneider-Creusot works, France has, of course, a great number of other important armament plants. Several of these are entirely new. The 75 mm. gun will shoot as many as 16 shells a minute and there are guns which have fired 2,000 shells a day. This means that 4,000 to 5,000 men will have to be continually on the job to make the shells needed for eight guns only. Of course, it happens very rarely that one gun is called upon for such an achievement; but it is generally said that the French fired during the battle of the Marne at least 150,000 shells, weighing approximately 1,350 tons. A factory equipment costing approximately $90,000 is required to turn out 100,000 rifle cartridges a day, enough for a regiment of men for a day's battle.

Science

Index of Refraction of Air.—The U. S. Bureau of Standards has carried out a long series of observations on the index of refraction of air for wave lengths from 2,500 A. to 9,000 A.; *i. e.*, the entire spectrum range easily recorded by direct photography. The observations were made for several temperatures between zero and 60 degrees C., and for several pressures, ranging up to one atmosphere.

Electrical Hazards in the Household.—According to its last annual report, the U. S. Bureau of Standards has been conducting a study of electrical hazards in the household and the means of reducing them. The results have been incorporated in an illustrated electrical chapter in the "Household Safety" circular, now about ready for publication. This publication is in popular language and is adapted to the intelligence and interest of school children as well as the average householder.

Testing Hemacytometers.—The hemacytometer is an instrument for counting the number of corpuscles in a given quantity of blood. At the request of manufactuers, the Bureau of Standards has begun issuing tolerances and specificiations for these instruments, and has undertaken the testing of them. Investigations carried out at the Bureau showed that the instruments were not generally so accurate as had been assumed. In some cases the instrumental inaccuracies were serious enough to cause errors in a count of from 25 to 100 per cent.

A Coming Pest of White Grubs.—The U. S. Bureau of Entomology states that a large flight of May beetles, well known as the parents of white grubs, occurred throughout Illinois, Wisconsin, Michigan, Ohio, Pennsylvania, New York, New Jersey and parts of other northern states during June, 1917. This event, says the Bureau, means that throughout the area mentioned white grubs will be destructively abundant in 1918, which will be the second year in the life of the resulting progeny. The Bureau has distributed an illustrated poster describing methods of control in the regions most seriously threatened.

German Geologists in the War.—In his presidential address to the Vesey Club, Dr. A. Strahan, F.R.S., stated that the Germans began three years ago to make geologists a part of their army organization. A geological staff was created under the direction of a professor of the University of Greifswald, and put to work on the western front, where its advice was utilized in connection with the laying of field railways, the water-supply of the army, the examination of marsh lands, the finding of road metal, and protection against landslides due to gunfire. It is said that much more extensive use was made of geological maps than has thus far been disclosed, and that the Germans, with an eye to possible future wars, have been making a very thorough geological study of the occupied territory in neighboring countries.

Fires in Scientific Laboratories.—On December 20th, a fire at the Fairport, Iowa, station of the U. S. Bureau of Fisheries destroyed the main laboratory, at which many important biological researches have been carried out, together with its valuable library. The Commissioner of Fisheries, in Washington, has sent out an appeal to authors having separates of their papers on fresh-water biology, ecology, limnology, biochemistry, and other topics of possible interest to the station, to help restore the library. On December 22d Lyman Williston Hall, the oldest science library of Mount Holyoke College, South Hadley, Mass., was destroyed by fire. This involved the total loss of the museums of botony, zoölogy and geology, besides the laboratories and libraries in these subjects and valuable books, equipment and papers belonging to members of the faculty. Appropriate museum material, out-of-print books, reprints, etc., to help replace this serious loss would be welcomed by the college authorities.

Arctic Hysteria.—In a paper dealing with the University of Oxford expedition to Siberia, of which he was a member, Mr. H. U. Hall, of the University of Pennsylvania, refers to the strking psychological effects of long daylight and long darkness in high latitudes. As to the former, apart from the tendency to shorten sleeping hours in order to make the greatest possible use of the long day, there seems to be a kind of stimulation of the nervous system, urging people to a feverish and purposeless activity. This is especially noticed in newcomers, but the natives are not exempt from it. On the other hand, the coming of the long winter night is followed by a kind of reaction, though no general depression of vitality is apparent. With the cessation of work the period of sociability begins, and the circumstances favor a lapse of self-control. This is the time when "Arctic hysteria" is likely to show itself. "Such, for instance, is a form of hysterical seizure for which the Tungus have a special name, in which the patient sings improvisations of his own which are likely to contain absurd exaggerations or laughable glorifications of himself." The writer records a case in which one of these hysterical boasters represented himself as a god and was killed by some of his fellow-tribesmen, who were also apprently affected by the disorder.

Astronomy

War Work of European Astronomers.—Prof. G. E. Hale reports that during his visit to Europe last summer he found several prominent astronomers engaged in war service. Count de la Baume Pluvinel had invented a device for detecting the presence of bits of shrapnel in the body; M. Chrétien was working on mathematical investigations in connection with the theory of airplanes. M. Deslandres and other French astronomers were in the artillery service; in England, the astronomer royal was occupied with testing certain instruments; and Prof. Newall was working on a new form of range-finder.

Mr. E. M. Antoniadi, the veteran observer of Mars, has resigned the directorship of the Mars Section of the British Astronomical Association, which he had held for 21 years. His elaborate studies of Mars extended over 12 successive oppositions of the planet, during most of which time Antoniadi made use of the 33-inch refractor of the Meudon Observatory. The successive reports of the Mars Section give evidence of his rare skill as an observer and draftsman, and are distinguished by the conservatism of his views with regard to the details of Martian geography reported by other astronomers, notably the late Professor Lowell.

More Accurate Observations of Meteors form the aim of some important recommendations recently made by the meteor committee of the American Astronomical Society. The committee advises that the publication in astronomical journals of articles on meteors or notes on their observation be discouraged unless the work bears indications of scientific accuracy. It is also highly desirable to unify terms and definitions in this branch of astronomy. The committee has drawn up a set of rules for determining radiants and deciding whether a radiant is to be regarded as stationary or in motion. (These appear in *Popular Astronomy* for January, p. 19.) Finally the committee recommends that immediate steps be taken to secure simultaneous observations of meteors by photography, and that such observations be published promptly. Visual methods are stated to be wholly incapable of solving some of the fundamental problems of meteoric astronomy.

An Ancient Persian Star Catalogue.—The Carnegie Institution of Washington has just issued an edition of Ulugh Beg's catalogue of stars, prepared by E. B. Knobel, who not long ago published an edition of Ptolemy's catalogue. Ulugh Beg was a Persian prince and astronomer, the grandson of Timur, and founded an observatory at Samarkand in the fifteenth century. His catalogue contains 1,018 stars, and was the first original one since that of Ptolemy, the epoch being 1437 A. D. An edition was published by Hyde in 1665 and another by Baily in 1843, but Mr. Knobel's is based on a great many more manuscripts (22) than its predecessors. He gives the places of all the stars for the year 1437, computed from modern star catalogues, and a comparison of these with Ulugh Beg's places. Mr. Knobel's edition brings out facts which seem to indicate that Ulugh Beg borrowed more extensively from Ptolemy than has heretofore been supposed.

A New Explanation of the Martian Canals, based on meteorological considerations, is put forth by Prof. W. H. Pickering in his 19th Report on Mars. He calls it the "theory of aerial deposition," and it differs radically from the irrigation-ditch hypothesis, now most familiar to the public. The new hypothesis begins by applying to Mars the "tetrahedral hypothesis" of Green concerning the shape of a cooling planet. Given the shape required by this hypothesis, there would be three depressed areas on the border of the north polar cap, in which water would collect when the latter melts. The moist air supplied by evaporation over these reservoirs would drain away to the south along certain definite routes, according to well-known laws of air movement over the surface of a rotating planet. Nocturnal cooling would produce clouds and rainstorms along these routes, and give rise to elongated marshes, constituting the broader and more conspicuous so-called canals. Instead of being artificial channels, intended to carry water from the melting polar cap to the southern hemisphere, they are, according to Prof. Pickering, natural features of the planet, and serve the purpose of preventing the water from being carried too rapidly, through the natural atmospheric circulation, to the south polar regions, where, wrapped at this season in the long winter night and subjected to the cold of space, it would be quickly withdrawn from further use to vegetable and possible animal life. Thus the marshes constitute reservoirs, furnishing water by evaporation during the Martian summer. From the shape and radius of curvature of the marshes Pickering calculates the force of the Martian winds, ranging up to 230 miles an hour, and from this maximum wind he finds that the minimum atmospheric pressure cannot be less than 7.5 inches of mercury. The temperature of boiling water on Mars would therefore be about 150 degrees Fahr. The very numerous narrower or secondary canals, which only appear later in the season, may be artificial, or may indicate the paths of local, more or less accidental showers.

Successful Handling of a Difficult Salvage Task

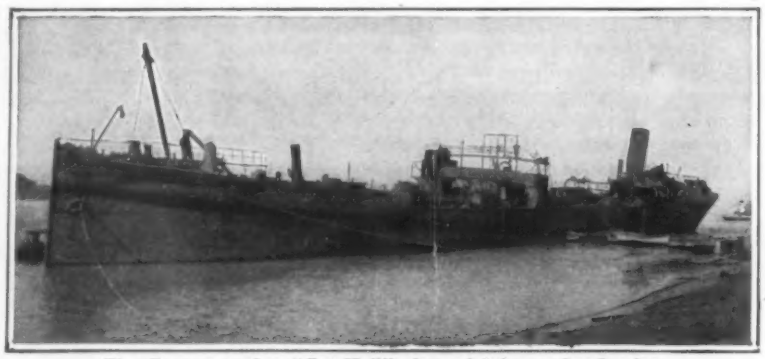
How the Tanker "Gut Heil" Was Rolled Over and Refloated

MARINE records contain very few instances in which overturned and sunken ships have been refloated. A vessel in that position presents a very awkward mass to handle. One of the foremost difficulties is that of controlling the water inside of the craft when the ship is righting herself and rising to the surface. The surging water may all too easily upset the boat's stability at a critical moment in the operations and heel her over so far that she will refill and sink again, possibly bottom-side up.

The recent salvage of the German tanker "Gut Heil" is of especial interest because the ship was commonly considered a total loss and a hopeless task for wreckers. The vessel foundered in the latter part of 1912 just after leaving the dock at Baton Rouge with a full load of 3,800 tons of oil. A chain cable fouled her propeller, and, while unmanageable, the steamer was carried by the current down upon two other vessels. Each tore a hole in the "Gut Heil's" port side, and through these wounds the waters of the Mississippi flooded into her. Sometime afterwards, her underwriters, the Standard Oil Company, tried to raise her. They succeeded up to a point, but the free surface of the water inside of her invited disaster—the fluid ballast started the craft heeling, and before her angular movement could be arrested, she rolled over, refilled, and sank to the riverbed on her injured side. The efforts to refloat her entailed an outlay of more than $100,000.

Nothing further was done by her underwriters save to recover some of the bulk oil she carried. After that, the tanker was abandoned, and just because she did not seriously interfere with navigation the United States authorities failed to dispose of her by blowing her up, as is generally done with derelicts. In the course of four years and more, the mud of the Mississippi worked into the sunken vessel and loaded her with substantially 4,000 tons of silt, adding just that much more to the improbability of ever raising the steamer. Such were the general conditions when a New York salvage concern was asked a few months ago to try to refloat the ship. The problem presented a number of angles which had to be dealt with successively in order to bring about a state of affairs that would favor her ultimate recovery.

First, the mud inside of her had to be removed; second, the two injuries had to be closed and the tanker otherwise made structurally tight so that compressed air could be used for the final expulsion of the water inside of her; third, it was needful that the distribution of water ballast and buoyancy should be susceptible of extremely nice control throughout all of the steamer's compartments; and, finally, very positive checks had to be provided to hold the boat from acquiring a sudden excess heel through the momentum induced when swinging into a vertical position.



The German tanker "Gut Heil" after arighting and refloating

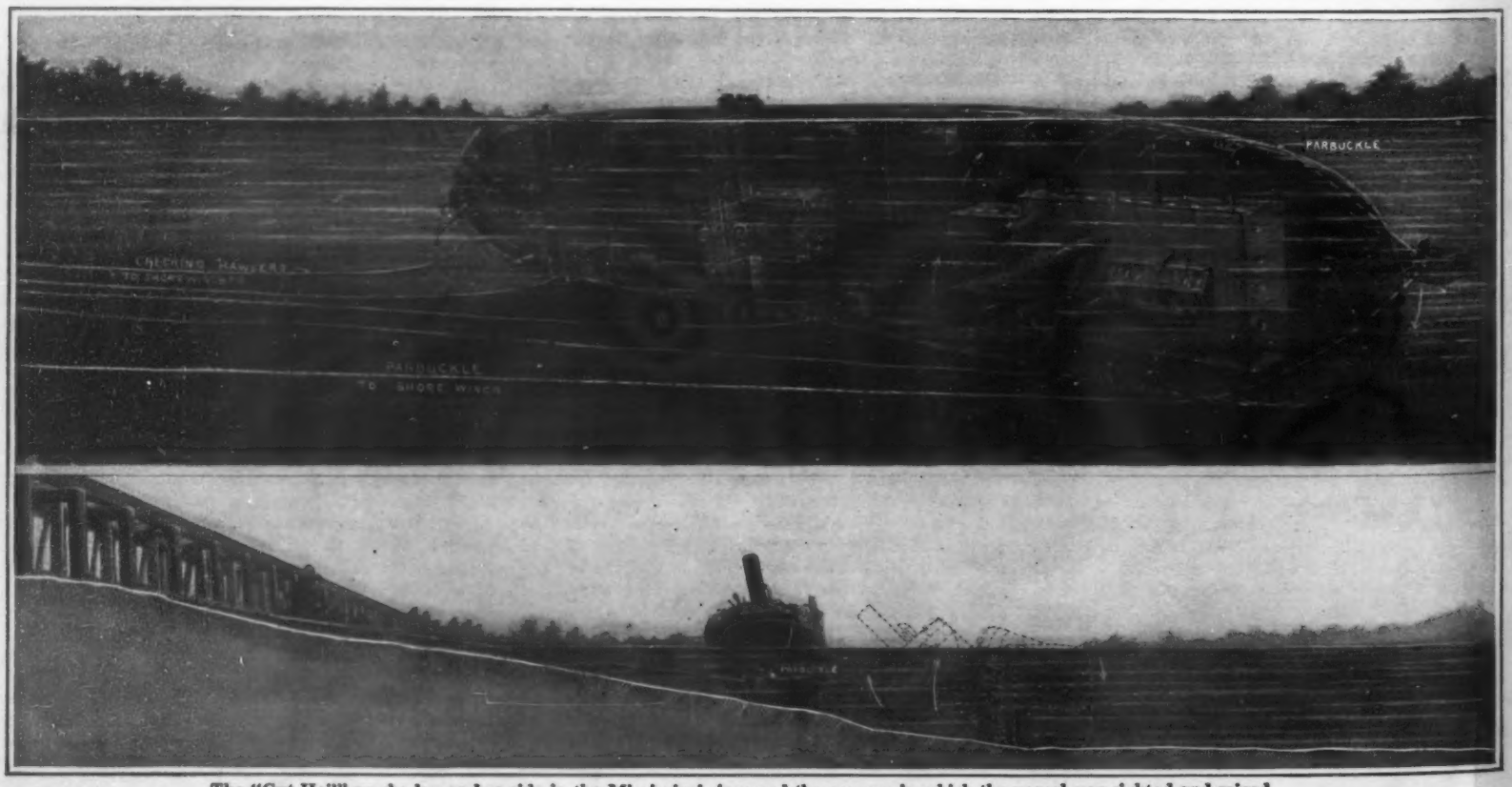
To free the "Gut Heil" of mud, the wreckers devised an ingenious and very effective compressed air siphon. This apparatus served the double purpose of loosening the mud and then raising it to the surface. The siphon handled the problem a good deal better than the available types of salvage pumps. With 3,000 tons of the silt thus removed it was possible for divers to enter the vessel and examine her structural condition. They found that her main longitudinal bulkhead was only loosely connected with the two decks above and, therefore, unsuited in that state to isolate the neighboring compartments so that they might be dealt with separately in applying compressed air for the final expulsion of their contained water. Binders of reinforced concrete, fixed in position while the tanker lay submerged, tied the decks and the bulkhead together and effectually sealed the joints. Reinforced concrete patches, put in position under water, also closed the two wounds in the hull plating caused by the collisions.

To each compartment—in most instances through the hatch covers—air supply and water exhaust connections were installed. The admission of compressed air forced the contained water outboard, and the release of the air pressure permitted the reëntry of the water. The air was supplied by hose, and all of these conduits were centered at a swinging platform erected upon the rail of the upturned side of the ship. Each lead of hose was there operated by its own valve, tapping flasks duly charged for the service. Upon this same operating stage were installed two groups of gages: one group, of the usual dial type, showing the volume of stored air available for the expulsion of water, and the other group, composed of 40-inch mercury columns, indicating the measure of air in each submerged subdivision of the vessel. This arrangement provided the wrecking master with a visible record of the internal distribution of buoyancy and water ballast; and by means of the bank of valves immediately at hand it was possible for him to make instant and very nice adjustments of these opposing forces as the movement of the craft necessitated.

But notwithstanding this seemingly complete equipment, the wreckers determined to take no chances. Therefore they secured to her at several points wire rope purchases which were led ashore to tackles attached to 40-ton blocks of cement buried in the ground. The tackles were operated by power-driven winches. Five of these purchases were made fast to mooring bits on the deck of the tanker on her lower side; and great credit is due the divers for the skilful and thorough way in which they did this difficult work. The sixth purchase in the form of a salvor's parbuckle, was secured to a deck bit on the upper side of the deck, then led over the upturned side, down through the propeller well, thence under the ship, and from there to the shore. The latter purchase made it possible to exert a righting force, while the five other purchases enabled the wreckers, at one stage of the work, to draw the ship shoreward into shallower water and, later, served to check the angular movement of the tanker when she was coming up to a vertical posture.

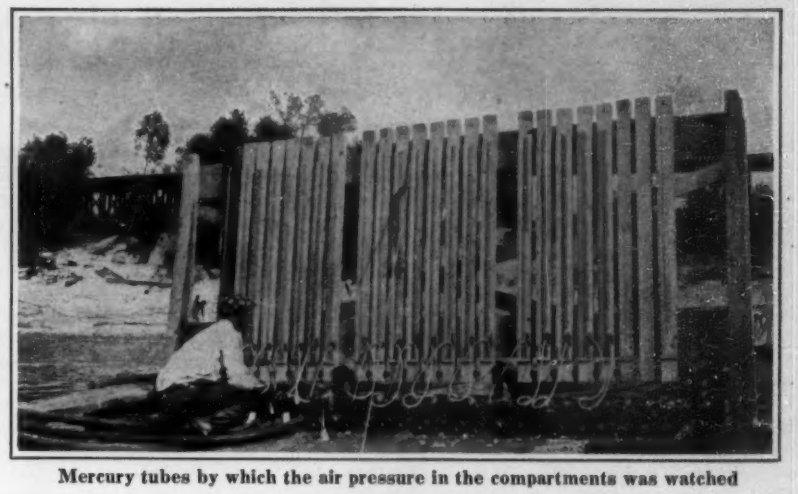
The salvors took no chances, as the foregoing preparations make plain, and it was wise, because they were thus able to deal with a number of unexpected contingencies. For instance, while the compressed air siphons functioned very well, indeed, still about a thousand tons of mud remained in the craft clinging to the upper surfaces of compartments at the time righting operations were started. When the steamer was beginning to free herself from the bottom and to turn on her longitudinal axis, this mud dropped away from its resting places and fell to the lower sides of the several subdivisions. This radically altered the "Gut Heil's" center of gravity, and for a while effectually arrested her angular motion. However, her changed position vertically gave the wreckers a chance to pull her farther inshore where she grounded and took a still better posture for subsequent work upon her.

When the ship was finally restored to an even keel, but while still resting upon the riverbed, it was discovered that the hole through the hull into the engine room had not been perfectly sealed by the reinforced concrete patch placed over it by the divers. That is to say, there was a leak which made it impossible to fill the space with compressed air in order to drive out the contained water. Therefore, it was decided to drain the engine room by suction pumps, and the leak was successfully stopped by means of a canvas patch applied externally. This patch was reinforced by strips of wood placed horizontally which, while stiffening the fabric and holding it stretched, left it flexible enough to adjust itself to inequalities of surface where the steel plating had been torn at the time of collision. This may seem an unimportant detail, but that expedient shows how it may be possible to deal quickly with a wound in any of our fight-



The "Gut Heil" as she lay on her side in the Mississippi river and the manner in which the vessel was righted and raised

The "Gut Heil" lying over on her side in forty feet of water



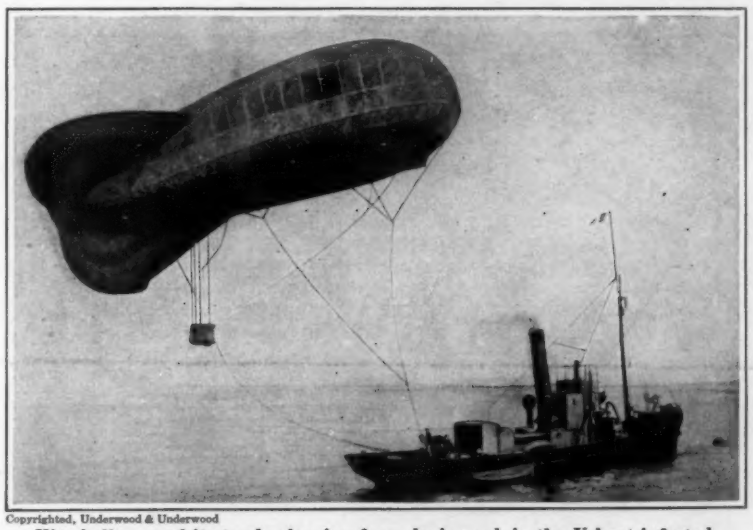
Mercury tubes by which the air pressure in the compartments was watched

ing ships or damaged war freighters. The usual woven mattress of hempen cable, such as is generally advocated in the naval service, is a clumsy thing to handle and not susceptible of rapid fabrication.

The "Gut Heil" is a vessel 321 feet long; and on a 21-foot draft carries 3,800 tons of oil. As she lay submerged she represented a dead weight of substantially 6,000 tons. The wreckers were engaged about two months in their preparations and the ultimate refloating of the craft. The latter operation was carried through in the course of a single day. When sunk, in 1912, the ship was valued at approximately $300,000. Today, she would bring a round million of dollars. Notwithstanding her five years' submergence, she is structurally sound, and her machinery, though very dirty, is in excellent condition. The turning over and refloating of the tanker, although commonly considered an impossible wrecking feat, illustrates what the resourceful scientific salvor can achieve now in the face of many physical difficulties; and it emphasizes the part certainly to be played by the wrecker in restoring to service ships that are sunk by routine mishaps or sent to the bottom by the ravaging submarine.

Fighting U-Boats from Towed Kite Balloons

AMONG other agencies brought to bear on the German submarines is the kite balloon of the type so extensively employed on the fighting fronts. The French navy, in particular, is employing a number of kite balloons with tenders for the purpose of spotting U-boats lurking near the coast and at the entrances to important harbors.



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Kite balloon and its tender leaving for a day's work in the U-boat infested zone off the French coast

The life of the kite observer at sea is full of thrills, especially during those times when he climbs up to the balloon swinging above the trawler and when he slides down the ropes to the deck of the trawler. It is said of these kite observers that some of their feats in this connection would compare most favorably with those of a trained tight-rope walker. But once in the basket of the balloon, the work is devoid of that excitement which is part and parcel of the work of the land observer. The U-boats can be readily spotted from a height of a few hundred feet, even when they are below the surface of the water, provided the sea is not too choppy and the light conditions are favorable.

A Roller Squeegee For Pavement Finishing

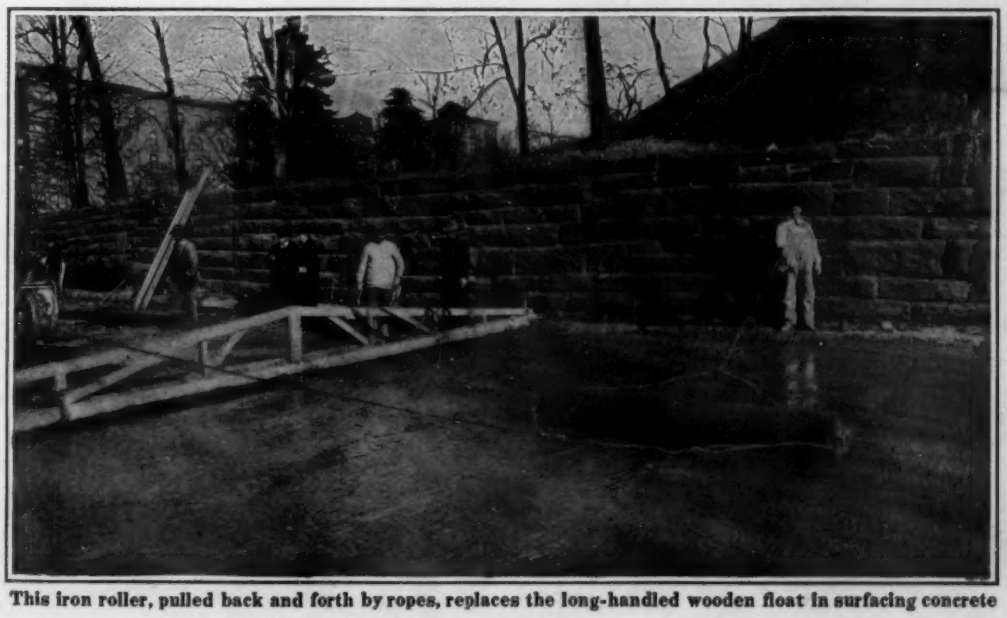
IN the construction of the first all-concrete street laid in Manhattan, an interesting device was utilized in order to give the best surface finish to the pavement. In place of the long-handled floats which require the use of skilled concrete workers, a roller of iron was substituted, which was drawn backward and forward across the wet concrete by a couple of ordinary laborers. The roller weighs about seventy-five pounds and is about four and a half feet long by eight inches in diameter. By means of cords attached to the ends of the axle, it was pulled across the street first by one workman, then by the other standing on the sidewalk opposite. The result could be observed quite plainly, a flow of excess water passing from under the roller and draining away at the gutters.

The final results of this system are not so perceptible, but tests of comparative strength and density show that there is a decided advantage in this method. Concrete slabs were finished both by hand float and by concrete roller and were tested at the Lewis Institute of Chicago. In the Structural Materials Research Laboratory it was demonstrated that there was an increase in strength of 20 per cent in the roller finished slabs as compared to the float finished specimens, also that greater density of the slab resulted, and was observable to about half its depth, due to compacting of the wet concrete under the roller.

This simple device is not only more effective but secures results more rapidly and at less expense than the former method of finishing by hand floats, as the use of the latter requires a good deal of skill, while the roller can be passed back and forth by untrained men. It leaves a surface that is very slightly waved, just uneven enough to afford a foothold for the horse and prevent a tire from skidding, and for that reason is more desirable than an absolutely smooth finish.

The transverse thoroughfare at 97th street across Central Park is, in fact, worthy of notice as a new standard in paving for New York city, for it embraces various experiments that were developed elsewhere and found successful. The concrete is of the proportions 1-2-3 and is five inches thick at the sides and nine inches thick in the center. Two inches below the surface it is reinforced with triangular mesh wire, and at intervals of about thirty feet it is provided with expansion joints of ¼-inch thickness that allow for contraction and expansion due to changes in temperature.

Some of the advantages claimed for the properly constructed all-concrete road are permanence and durability under severe traffic and weather conditions, an even surface that has least obstruction to the pull of the horse or motor power, and a sufficient irregularity and gritty quality under the wheel or hoof to check a tendency to slip or skid.



This iron roller, pulled back and forth by ropes, replaces the long-handled wooden float in surfacing concrete

The Current Supplement

THE leading article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2197, for February 9th, is on *Direct Selections in Pure Lines*, which gives the results of important recent investigations of plant breeding by an eminent botanical authority. *Bread-Fruit and Its Possible Uses* tells something of a food product of tropical climes, and is illustrated by two excellent photographs. *A Novel Cure For Frozen Plants* is a timely note, accompanied by two pictures. *Some Reforms of the Patent System* is a paper read before the Examining Corps of the Patent Office by the Assistant Commissioner. Many contrivances have been devised for drawing mathematical curves, but the one described and illustrated in the article entitled *A Compound Harmonic Motion Machine* appears to meet the requirements more completely and accurately than any heretofore proposed. Several photographs show the construction quite clearly, and the article is accompanied by a great number of curves of varying characters that illustrate the principles and capacity of the apparatus. This article will be concluded in the next issue. The paper on *The Complexity of the Chemical Elements*, by Professor Soddy, is concluded in this issue. Other articles of interest include *Effects of Hearing vs. Seeing*, *The Geologic Role of Phosphorus*, *Sugarless Candy*, and there are as usual, a number of shorter articles of value.

The Purification of Asbestos

COMMERCIAL asbestos contaminated with iron compounds may be purified by treatment with a two per cent aqueous solution of oxalic acid for 48 hours, followed by washing with water. The strength of the asbestos is not affected by the treatment. A band of asbestos 20 mm. wide showed at 14 different places an electrical resistance of 600 to 700 ohms; after treatment as described, the resistance increased to 150,000 ohms. An alternative method consists in heating the asbestos for 20 or 24 hours in a current of hydrogen or carbon-monoxide at about 400 degrees C. and then washing with very dilute hydro-chloric or sulphuric acid and afterwards with water.

Strategic Moves of the War, January 30th, 1918

By Our Military Expert

THE terse statement so often seen in the British official telegrams from their front that "There is nothing of special interest to report" can well be applied to the military happenings of the past two weeks on the several fronts. In the west there have been various minor actions all along the lines from the North Sea to Alsace resulting in claims of prisoners and minor material taken and of mutual destruction of trenches and dugouts. Perhaps the lessening of the hardships of winter have made or will soon allow an increase of military operations which would forecast the beginning of heavy fighting. One of the most important operations recently was in the North Sea coast section to the east and south of Nieuport near Lombaertzyde and St. Georges where there is a sharp salient in the Belgian line which the Germans may have been trying to crush in. As a whole there has been little or no change on this part of the front protecting Calais during the past three years, although the German trenches here have been exposed at times to heavy bombardments, especially from British ships. Reports also give accounts of spirited raids on the Aisne front north of Souain and Avocourt where so many desperate struggles have taken place during the war. The vicinities of St. Quentin, Verdun, Lens and LaBassée have all furnished their quota of small encounters that presage the renewal of offensive operations at an early date. The winter has so far held the western lines in heavy snow and zero temperatures; but the cold weather does not last long in Belgium and northern France and the spring thaws and warmer weather can be expected by or before the middle of February.

During the past three years both the Central and Entente Allies have begun operations on a large scale during adverse weather conditions; it is therefore not improbable that important movements may be begun in a few weeks. The Germans began their Verdun assaults in 1916 in the beginning of February; if they intend to start their long advertised grand operations on this front, heavy fighting may be expected at an early date.

This final blow appears to be the one topic of interest in Germany if newspaper accounts are to be credited; the belief that this is to be the last crushing stroke to be delivered against the British and French appears to be universal in that country. Such hopes are founded upon the anarchy existing in Russia and the consequent withdrawal of the best troops from the eastern front. For some time the withdrawals were by piecemeal, new divisions being formed on arrival in the west. Recently entire divisions have been moved west—apparently with some ostentation as the troops pass through Berlin and other large cities and this display is evidently with a two-fold purpose. The one purpose is to restore confidence among the German people who have been much disheartened with the effects of another winter of war, and the other is to cheer up the troops by the display of enthusiasm and confidence on the part of the civilian element.

There has been a promise of Austrian troops being also sent to the western front; but present conditions in Austria, where great discontent reigns, will hardly allow such a move, as the conviction is growing in the country that Austria is now only a German catspaw. The Russian revolutionary movement, coupled with bad food and lack of clothing and fuel, has resulted in strong popular demonstrations in Austria, leading to strikes, riots and dangerous unrest throughout the country. Similar unrest is traceable in Germany where it is believed the pinch of want and starvation is greater than ever before; but here the autocratic military regime is in control and the people can do nothing though the political situation is permeated with divisions on all sides. Even the chaos in Russia and the Italian disaster and retreat had only a temporary, encouraging effect; the shortage of food and lack of supplies with all their attendant miseries are undoubtedly leading the civilian element to believe that ultimate defeat is certain. The military party is holding out with the idea of gaining support; but even here diversity of views appears on all sides, and there is such lack of agreement and of unity that the Kaiser and his advisers must have great difficulty in composing the differences. While all the Entente Allies are having their troubles, the conditions in Germany are as bad, if not worse, for adjusting disputes to every one's satisfaction. And the present plans of the militarist party as to territorial annexations are so grandiose and extreme that the thinking element of the country is becoming aroused to the many possible future dangers.

Alsace-Lorraine is one shining example where forty years or more of effort have utterly failed to make the country sufficiently German to admit of self government. And now it is seriously proposed by the German peace delegates at the conference at Brest-Litovsk to cut off from Russia all of Courland and the other Baltic provinces so that practically the best part of the Russian Baltic coast would remain in German hands. Such a step would take from Russia, Courland, Lithuania, Esthonia and Livonia; its ultimate effect would be to make of Russia, as in the case of France, a mortal enemy, for the government there will not always remain in Bolsheviki hands. Some authority, more stable and more amenable to the will of the Russian people, is sure to come out of the present anarchy; and a nation of so many millions inspired by hatred and a feeling of injustice will be no enemy to be despised in future. The effect would be to establish another Alsace-Lorraine problem on Germany's eastern front, only that the problem would be a greater and more dangerous one. The limits proposed for German annexation will bring Germany to the borders of the Ukraine which has already declared its independence of Russia proper. What demands will be made here cannot well be forecast in the limits of this article; but it should be remembered that, if Ukraine independence is preserved, it will be the second largest state in area in Europe, having 850,000 square miles and a population of 30,000,000. The

Where Russia stands under the latest developments

Ukranians, as a people, have spread also into Galicia, Bukowina, and Hungary. An independent state here would shut all the remainder of Russia off from the Black Sea, through which three-quarters of the exports and one-fifth of the imports pass.

The entire district is called the granary of Russia for it supplies the rest of Russia with wheat, oats, barley and other foodstuffs. A glance at the map will show how effectually Russia, with the proposed arrangements, will be practically forbidden the sea and will be placed in economic subserviency to her German neighbor on the west. At present the Russian armies seem entirely demoralized and are melting away through the desertion of entire units whose officers have been removed or have fled. Much of the military material is said to have been abandoned in the snow, heavy guns being left in their positions with little or no ammunition. Many parts of the Russian western front are entirely open and reserves refuse to relieve the men who, in other places, remain in the trenches. Under such circumstances discipline is out of the question; so that the only salvation appears to be to withdraw to special positions in rear of the present lines and to endeavor to reorganize the armies under trained officers and leaders if such can now be found. Resistance at present is out of the question; therefore the Germans will have a free hand for any military operations or advances that they may wish to make on this front.

While the Austro-German Allies have, in a military way, had a free hand on the eastern lines, it will by no means be the same when operations are begun in the west. By the collapse of Russia, 900 miles of front have been released from military activity and the Italian disaster shortened the battle lines in Italy by 150 miles; thus the Central Allies have greater strategic freedom on both the western and Italian fronts. But the Entente Allies have by no means been inactive; they have strenghtened their positions for defense and have reorganized and rearranged their tactical positions, heretofore held for offensive movements. Both the French and British are awaiting the threatened onslaught with calmness and confidence that their lines will hold, no matter how strongly nor where they may be assaulted. It has been estimated by good expert authority that the Germans have now on the western front 165 divisions or approximately two million men; this is stated to be a greater number of divisions than all the Allies combined, excluding the Italian front. The German strength is said to be increasing at the rate of seven to fifteen divisions a month and may therefore amount to two hundred or two hundred and twenty divisions by the time all are assembled in the west.

Strong attacks at different points with such enormous forces could readily be made; the impression is growing that, when these attacks come, they will be at the two ends of the lines; viz., towards Calais and Nancy with possibly simultaneous attacks in Artois, the Champagne, and Alsace. But today the Entente Allies stand to arms with better morale than ever before. They know the ground they occupy with its strong and weak points; they have taken from the Germans many commanding points and any attack by the Germans will be at a disadvantage. The Entente Allies have an artillery superior in numbers and caliber to that of the enemy and their supply of ammunition is greater in amount and better in quality than that of their opponents. So that they can look forward with confidence to an ultimate success though the losses on both sides may dwarf anything that has gone before, even the terrible holocaust of Verdun where hundreds of thousands on both sides laid down their lives in streams of blood.

In Italy, the recent change of high command on the part of the Austrians was thought to presage an attempt to break through the Italian lines, to reach the plains at Bassano, and to throw back the Italian army to the line of the Adige—in other words, to secure a success that would put Italy out of the war. But all these surmises of military experts have vanished for the present into thin air largely through the results of an advance made by the French troops against the enemy's lines, south of Quero in the general region of Monte Tomba. Reconnaissances made in the last few days have shown that due to the French advance and to the threatened turning of their lines the Austro-German forces have evacuated quite an extent of territory behind and to the north of Monte Tomba from the Piave River westward. Their defence lines have now been withdrawn to Monte Spinonica further back in the mountains and some distance away from the plains, and it is by no means certain that further withdrawals may not be necessary before milder weather comes on. As a whole it would appear that the pressure heretofore exerted by the Austro-Germans is being materially lessened with a corresponding rise in the prospects of a successful resistance to any further advances into Italy.

But little has been heard recently of happenings in Palestine in connection with the British advance to the north after the capture of Jerusalem. The British campaigns in the near east have been criticized as being isolated operations and leading to no definite results. When the German Mittel Europa schemes and the proposed Berlin-Bagdad railway as a necessary adjunct are considered, it can be understood how the British successes in the two widely separated areas have effectually blocked the Kaiser's plans. If the forces in Palestine can gain ground to the north as far as Aleppo and the junction point ten miles north of that area with the main Bagdad line, then all the Mesopotamia section of the railroad will be lost and only that portion from Constantinople to Adana will be left in Turkish hands. Even the route to Bagdad via the Euphrates River will be closed to them and Mesopotamia and Palestine will be British territory. It was absolutely essential to forestall the Germans and Turks and to inaugurate the Mesopotamian and Palestine campaigns before the improvement and completion by them of the Bagdad railway.

Improving War Bread With Lime-Water

A Disagreeable Feature of the French Intensive Milling, and How It Was Remedied

EVEN in America the pinch of war has caused the raising of the percentage of wheat used for white flour from 72 to 74¼. In France, where formerly little more than a third of the grain was employed in making flour for the French bread, famous all over the world, the percentage has been raised successively to 72, 76, 80 and finally 85. Up to 80 per cent the quality of the bread seems to have remained excellent, but after the last increase to 85, many protests began to come both from the soldiers and from the general population, among whom probably bread is a definite staple of life to a greater extent than in any other country.

These complaints were to the effect that the bread was sour, heavy, unpleasant of taste and of odor, with an acrid after-taste, and worst of all indigestible, tending to irritate the intestine. The matter finally became so serious that Lapicque and Legendre were commissioned to investigate the subject. In Prof. Lapicque's report he explains that the 85 per cent flour consists of the farina, or inner white part of the kernel, plus an addition of the "middlings" or "thirds," with an unavoidable admixture of bran. Contrary to the popular belief that the bran was the cause of the digestive troubles caused by the war bread, it was found that these middlings were to blame for its unsatisfactory qualities.

This middle portion of the grain, lying between the envelope of cellulose and the central white part of the kernel containing gluten and starch, consists mainly of the aleurone layer and the germ. The cells containing aleurone have a special function; at the moment of germination, when the germ is sprouting into a new plant, it is their office to attack, dissolve, and transform the inner part of the kernel in order to nourish the young seedling, which thus is enabled gradually to absorb all the nourishment stored in the grain.

This function is performed by means of ferments known as diastases. When these find their way into the flour they begin to ferment energetically as soon as moisture is added, and it is to this fermentation that the objectionable qualities in the 85 per cent war bread were due. These diastases, which are definitely acid, affect the dough during the time it is set to rise. They not only make it darker, but modify the gluten, interfere with the rising so as to produce a bread more compact and heavy, and alter both taste and odor, which are sour and acrid, with an unpleasant butyric flavor.

Having found the element responsible for the injurious action, the next step was the endeavor to find some means for suppressing the ill effects of the diastasic action. "One of us," says Professor Lapicque, "working with Dr. Palazzoli, observed that under the action of the vapors of ammonia the middlings changed color, turning from gray or reddish to a lemon yellow. The same yellow tint was produced under the action of any alkali whatever, and under the microscope it was seen to be definitely localized in the aleurone-holding cells; finally, it was also produced in the soluble matters obtained by macerating the middlings in water. It is, therefore, a sign of neutralization and experiment proved that the macerations which had undergone this change of color were no longer subject to the acid fermentation of which we have spoken. *The middlings which had changed color had at the same time lost most of their injurious action upon the flour.*"

The investigators next instituted some practical experiments at one of the military bakeries.

The alkali chosen, because of its hygienic qualities, its cheapness and ease of manufacture, was lime-water. Here the middlings were treated separately until the significant change of color was produced, then used with the white flour. The resultant bread was most successful. The bread was sweet and savory, without any sour or acrid after-taste or flavor. Another important point in its favor was its keeping quality, one of the criticisms of the untreated war bread being its tendency to become mouldy in about five days, a serious matter because of the inevitable delay often caused by transportation difficulties. Moreover the bread was lighter in color and thus more pleasing to the eye.

This method employed for the army bakeries had to be modified for the general public, however, since civilian bakers now receive the "national flour," as it is called, already mixed. This national flour consists of wheat milled at 85 per cent, with the addition of varying amounts of other cereals, principally maize. As soon as the report regarding the new bread became known, numerous bakers applied to the Department of Inventions for a proper formula for making it. Further experiment proved that it was not necessary to neutralize the diastasic portion of the flour separately. Excellent results are obtained merely by using lime-water instead of plain water in the ordinary process of making up the dough. There is no danger of thus introducing too large a proportion of lime, since only one gram is used in three kilograms of bread, *i. e.*, one part in 3,000. As a writer in *La Nature* (Paris) remarks in commenting upon this feature: "Many other foods contain as much or more; thus, in drinking a glass of milk one gets as much as in eating a kilogram of bread (2.2 pounds).

The Academy of Medicine has also given its sanction to this method of preparing bread. It is to be remembered, in fact, that this middle layer of the grain with the germ is rich in mineral salts, especially phosphates, and in albuminoids; bread containing it is, therefore, more nutritious than bread made of white flour, provided the former can be digested and assimilated.

No change in the practice of breadmaking is entailed by the new recipe. The successive yeasts and the dough are made and worked as usual. But the dough is made up with *lime-water* prepared as above instead of with ordinary water. The bread thus made is better raised; its crust is firm; it has an agreeable odor. Its flavor is sweet, without acidity or acridity. It leaves a pleasant after-taste. It keeps well.

It is to be hoped that some of our own bakers will experiment with this method, even though our flour is not yet milled with so high a percentage of the grain. In view of the present shortage of sugar still another recent French discovery might be made use of to advantage. This is the use of the glucosates or saccharates of lime instead of plain lime-water. This was presented to the Academy so recently as September 17th. Its author, M. Georges A. Le Roy makes the following statement:

"The glucosates of lime can be employed with advantage, from the point of view of taste, ability and conservation, in place of lime-water, to improve bread made from flours with a high milling percentage, such as the 85 per cent flour now prescribed. The glucosates employed are prepared by digesting, in the cold, an aqueous solution of commercial glucose (tested for freedom from traces of arsenic), with milk of lime. We thus obtain, after filtering, limpid solutions of glucosates, containing, according to the proportions used, one part of lime to one or two parts of glucose. Since solutions can thus be obtained sufficiently concentrated they are more easily managed in breadmaking than plain lime-water, wherein there is only about one gram of lime per liter of water. The sucrates or saccharates of lime can also be used, but are less advantageous because less soluble than the glucosates; moreover sugar is now very dear.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

More Things to be Learned from the War

To the Editor of the SCIENTIFIC AMERICAN:

Your editorial in the issue of December 1st, "Shall We Learn from the War," was most admirable. The thought could have been extended further, to the international field.

The nations have long been engaged in a work quite as mischievous in that field as their repression of coöperative combinations have been in the domestic domain—perhaps more so. This consists of the endeavor to preserve their home markets from foreign competition while bending every effort to break into the markets of their neighbors. The net result of this mutual exclusion has been a mutual strangulation of what should have been commerce profitable to all.

One nation may have a vast area, with illimitable natural resources. It thinks to be economically independent of the rest of the world. This might be all right were all nations so fortunately situated, though even in that case it would not be well for any nation to live to itself alone. But all are not so situated, for there are other nations inhabiting small areas, poor in natural resources, which need large quantities and varieties of supplies from other lands, for which they can pay only with their own products. All trade is barter, and not a dollar's worth of goods comes into a country without calling for a dollar's worth to go out of it. This is something the Protectionist's mind seems unable to grasp.

I believe this is the secret of Germany's outbreak, which she is too stupid to understand and therefore has been unable to explain to the world. In no other way is their talk of "a place in the sun" and their "economic security" intelligible. The supplies and the markets they needed were under other political control, and their dense intellects could only conceive of access to them by substituting their own for foreign control. While such ideas persist economic wars must lead to military wars.

Commercial freedom, I believe, would be a boon to the greatest and richest of nations. To many of them it is a matter of life and death and they do not know it. Had Germany the wit that Great Britain possessed three-quarters of a century ago she would have repealed the more burdensome of her tariff taxes, warded off the threatened change of commercial policy of England, started on a new career of industrial and commercial growth and, more important, the example of two such great nations engaged in commercial coöperation instead of commercial war would have brought the whole world to realize the benefits of commercial freedom. She would have gained more than she could by the utmost realization of her dream of conquest.

Boundaries are useful and even necessary for the demarcation of jurisdictions for the administration of public affairs—as necessary between towns, counties and states as between nations. For them to be made barriers to the free intercourse of the peoples of the earth is to make them antagonistic to the progress of civilization. I do not see how a civilization worthy of the name can arise while boundaries are so used.

STEPHEN BELL.

Millburn, N. J.

The Infra-Red Ray and the Submarine

To the Editor of the SCIENTIFIC AMERICAN:

In the November 3d issue of the SCIENTIFIC AMERICAN we read a letter referring to our article "Air Transparency for Infra-Red Rays," published in the December 26th, 1914, issue of the SCIENTIFIC AMERICAN; the author of the letter wishing to know whether the greater transparency of air for red and infra-red rays could be used for the detection of submerged submarines.

To this query we beg to answer that, while the transparency of air for radiations increases from the ultra violet to the infra-red, a very different law holds good in the case of water: Abney and Festing (Philosophical Transactions. 172 p. 887 1882), have shown that, with the exception of a small region in the neighborhood of 1,000 A. U., for which water remains transparent, the infra red and even the extreme red radiations are more absorbed than any of the visible radiations.

GUSTAVE MICHAUD.
J. FICH. TRISTAN.

San Jose, Costa Rica.

Panama Canal Tolls

To the Editor of the SCIENTIFIC AMERICAN:

Freights across the Pacific have advanced from $5.00 gold per ton to $50.008 gold per ton and to all other parts of the world in about the same proportions.

The Panama Canal carried a tonnage for the fiscal year closing June, 1917, of about seven million tons (exactly 7,229,255 tons) at 50 cents gold per ton or $3,500,000 gold.

Why not have an Act of Congress passed increasing the tolls in the same ratio more or less as freights have advanced and make them $5.00 gold per ton and give the government a revenue of $35,000,000 or still better a simple method would be to have the tolls 10 per cent of the sworn freight list.

No class of persons can stand this tax better than the steamship owners who are reaping a harvest at present beyond their wildest dreams of fancy. The 1,876 vessels using the Canal last year were as folllows:

Flags	
United States	464
British	771
Norway	150
Japan	72
Chile	90
Peru	86
All other flags (16 nations)	243
	1,876 vessels

The Government needs the money and this small proportion of the enormous freights would be paid without the steamers feeling the difference. Congress should consider this at an early date.

M. HALL MCALLISTER.

San Francisco, Cal.

The Deepest Mine

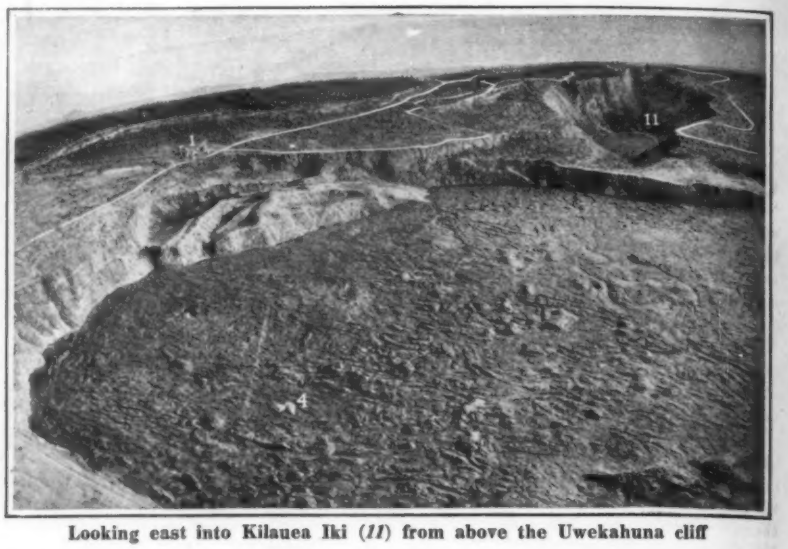
To the Editor of the SCIENTIFIC AMERICAN:

Referring to the May 12th, issue of the SCIENTIFIC AMERICAN, about the deepest mine in the world being the Morro Velho gold mine, with a depth of 5,900 feet. I wish to bring to your notice that the deepest mine is, not the Morro Velho gold mine, but is the St. John del Rey copper mine in Brazil, having a depth of 6,800 feet.

C. Y. WANG.

Hankow, China.

Halemaumau crater (*5*), looking toward the Uwekahuna fault-scarp (*2*)



Looking east into Kilauea Iki (*11*) from above the Uwekahuna cliff

Thirteen-foot Model of the World's Most Active Volcano

Faithful Reproduction of the Kilauea District in Hawaii on a Scale of 1-1500

By Professor Reginald A. Daly, Harvard University

RECENTLY the Harvard University Museum has been enriched with a superb relief which portrays the Kilauea district in Hawaii. This model is a gift due to the generosity of Mr. Robert Wilcox Sayles, Curator of the geological collections in the Museum. In 1913 he commissioned Mr. George Carroll Curtis to undertake the arduous task of constructing a relief that should faithfully render, in form and color, the famous center of volcanic activity. Though the problem was more difficult than any other attacked by Mr. Curtis, his success was confidently expected because of the perfection of his large models of the Funafuti and Bora Bora coral-reefs, already among the chief treasures of the Harvard Museum.

Mr. Curtis spent three months in Hawaii, collecting the field data by survey, color sketch, and photograph. While there he enjoyed the hospitality of the Hawaiian Volcano Observatory, which, under the direction of Dr. T. A. Jaggar, has given liberal aid to many scientific visitors at the volcano. Kite photographs, taken by Mr. J. Fred Haworth of Pittsburgh, were specially useful in furnishing details of form not otherwise recorded and in controlling the proportions of all elements of relief. Three and one-half years were occupied with modeling, casting and painting. The artistic skill with which the delicate, infinitely shaded colors of nature are reproduced is obvious to anyone who knows the real Kilauea.

The relief is circular, 13 feet in diameter, and represents an area of 15 square miles. The scale, 1 to 1,500, is cleverly indicated by the sizes of buildings and human figures, and by the sizes of automobiles modeled on the roads. Unlike most other models, this one has no exaggeration of the vertical elements. The thousands of individual, large trees have been separately modeled.

Detail of the Halemaumau crater, showing the low stand of the lava in 1913

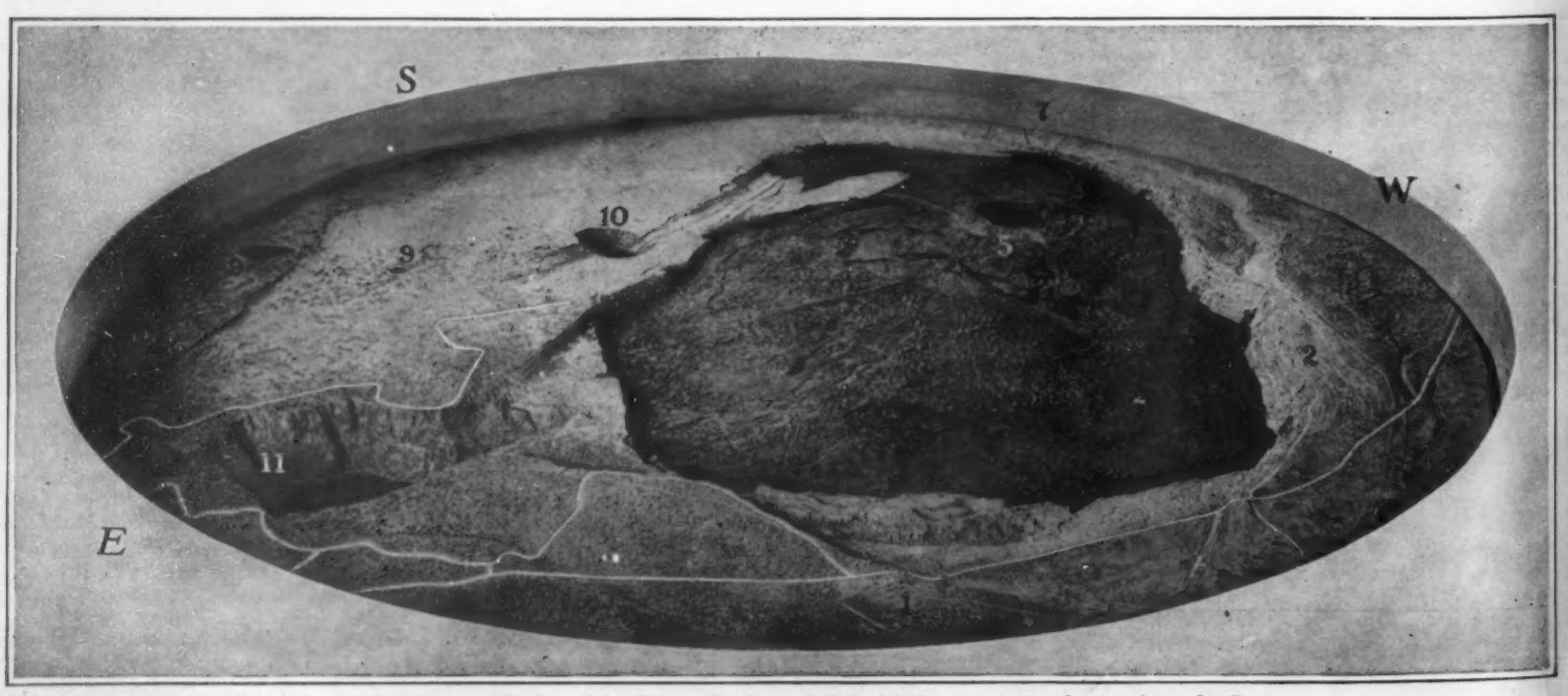
A painted panorama surrounding the model shows in perspective the snow-covered Mauna Kea to the northward, the somber dome of Mauna Loa on the west, and the ocean on the south.

In the accompanying photographs each of the more important localities is indicated by a number.

A general feature of the Kilauea district may first be noted. The heavy vegetation of the windward, northeast part makes lively contrast with the treeless condition of the desert on the southwest, illustrating the remarkable climatic control exerted by the trade winds in many tropical islands.

The main element of relief is the Kilauea sink, measuring three miles by two miles. The walls of the big depression are chiefly composed of thin, superposed lava flows, the exact sources of which are unknown. These older lavas constitute the top part of an unsymmetrical dome on the flank of Mauna Loa, the master volcano of the island. The partial foundering of the broad apex of the dome has caused the Kilauea sink. On the floor of the sink, many lava flows, of the last 75 years, have built up a low, black, basaltic cone bearing the active crater, Halemaumau, "the House of Fire"(*5*). The top of the Uwekahuna cliff (*2*), the highest overlooking the depression, is 500 feet above the floor. The model clearly shows the sink to have been developed by the subsidence of blocks of the older lavas along highly inclined fractures. Some of the blocks are buried beneath the new basaltic cone; others are still visible, with their cliffs of displacement (fault-scarps) well

(*Concluded on page 137*)



Thirteen-foot reproduction of the Kilauea district modelled with the utmost attention to minute detail

Our Enemies in the Air

How Germany Is Preparing to Meet American and Allied Air Fleets

By C. Dientsbach

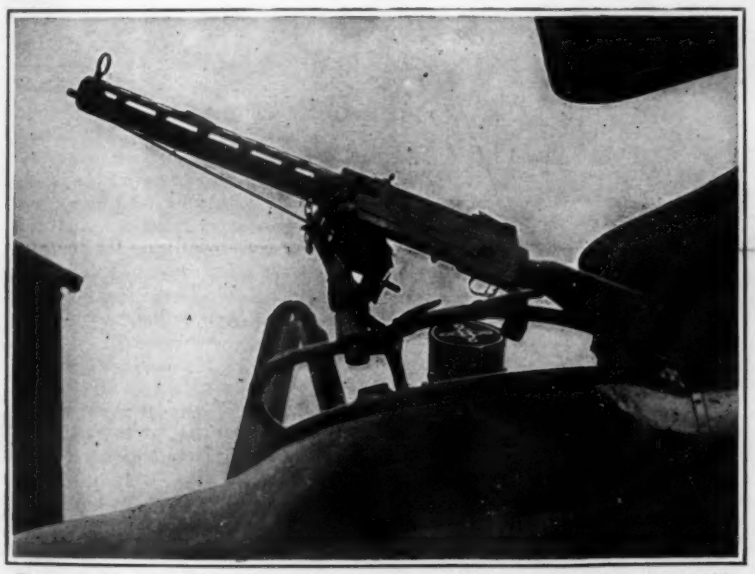
SECRETS in military aviation are short lived. The design and equipment of an airplane remain secret only until that particular type is incorporated in the air service; three months later the enemy knows all he cares to know regarding that machine. He can take such ideas as he approves of and reject others. For if the new type makes its appearance over the fighting fronts in fair numbers, several machines of that type are bound to be shot down behind enemy lines.

That is why the French and British know all about those German types which have been employed on the fighting fronts for several months or more; conversely, the Germans have the very latest data regarding French and British aircraft technique. It is a case of perfect reciprocity and must ever remain so, while present conditions of aerial warfare obtain.

Which leads up to the subject of German airplanes and airplane equipment, and how the Germans are feverishly developing their aircraft industry in order to compete with the united output and technical skill of Great Britain, France, Italy and the United States.

Lineup of the speedy Albatross battleplanes forming Baron von Richthofen's "traveling circus"

Much has been divulged by actual inspection of German machines brought down almost intact behind Allied lines. In general, the vehicle of the German pilot is small and sturdy, most heavily engined (even the smallest chaser planes have 175 horse-power), constructed with the least number of struts and wires, to operate for all time, because any weight which might be allowed for devices insuring ease and safety of flight must be immediately commandeered for such necessary fighting requisites as machine guns, ammunition, more



Rear gun of a two-seater German reconnaissance plane, mounted on a rotatable cradle. This is a Parabellum type gun

A typical German reconnaissance machine. Note the engine housing, exhaust, propeller pot and general streamline

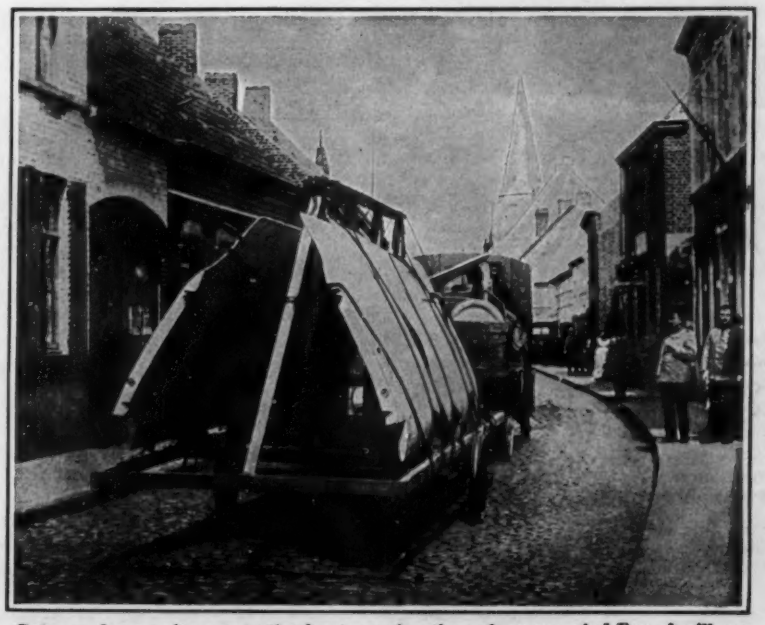
equipped with a simple wheel gear, cleverly streamlined and well armed. It is at once evident that such machines are only intended for post graduate pilots who have been trained by degrees on the various old military machines which have long since passed out of date, but which were comparatively easy to fly. The new machines are designed with a full understanding of the principles of automatic stability, yet, unlike the old Taubes, embody them only so far as to eliminate vicissitudes; otherwise, they are "neutral," tending neither to get into nor out of equilibrium, because more stability would prevent the sudden, swallow-like turning and wheeling, right and left or up and down, that is so essential in dodging the enemy's fire from the air or from the ground.

But the increased difficulty of flying, due to this necessary lack of inherent stability, seems trifling compared to the dangers of landing resulting from the excessive speed now made by the chaser planes. Captain Boelke, the famous German "ace," when writing to his parents about his early career, stated that the one thing practiced to the exclusion of all else while training for aerial fighting, was landing; yet during his first examination his machine had turned a somersault after landing.

It seems as though military machines will remain extremely difficult or dangerous speed and greater climbing ability. And after all, the airplane that has less to fear from the enemy is safer in war than that which is more secure to fly but inferior in defense. For the same reason the margin of safety against breakage has been incredibly lowered, and the aviator must now trust his life to ideal material and workmanship, and that "grooming" for which money is spent with lavish hand. The fact remains that transcendent speed and maneuvering ability tax a machine's strength most severely.

Presently the Germans are making their reconnoitering two-men type and the bombing three-men type comparatively small and fast, following the practice of the smaller or chaser planes. In the case of their largest and slowest machine, the Gotha bomber, which is named after the location of the factory where it originated, speed and maneuvering ability are backed up by an improvement in the armament. In this bombing machine practically all "blind areas" or "dead angles" of fire have been eliminated by mounting a third machine gun under the fuselage which is shaped like an inverted channel or floorless tunnel, so that its fire can be brought to bear on all points heretofore in line with the tail members. In other words, the "blind spot" formerly existing under the tail of an airplane and taken advantage of during a combat, has now been eliminated in the Gotha bomber.

The only concession to the German aviator's comfort is, in all types, the commendable practice of carrying the exhaust from the engine beyond any possibility of mixing with the air he breathes. And well that may be so; for the physical condition or efficiency of the airmen is still more important than that of the machine; and the Germans have also recognized that on a fighting plane one man must essentially be capable of doing the work of two, and do it well. Again, the inert weight of too much personnel cuts down war efficiency even more than needless weight of machinery.



German plane on its way to the front, passing through an occupied French village

As the requirements of an ideal warplane have been gradually revealed in the course of the long war, the purely aerodynamical advantages of the monoplane—more lift and less drift of the wings themselves—dropped more and more in the estimation of the designers. In the complicated maze of compromises that go to solve the warplane design, the structural advantages of superposed wings—more surface and strength, less size and weight—came to the front. Today the biplane rules supreme, but triplanes and multiplanes may yet offer the acme of military efficiency.

Something of the spirit of German military aviation may be gleaned from the reports of German journalists who were recently invited to visit the flying grounds of Doeberitz, near Berlin. Indeed, more can perhaps be learned from these reports than from the flying machines and flying men who have from time to time fallen into Allied hands, just as Wilbur Wright, in 1905, remarked to the writer: "If a perfect flying machine were dropped onto the

(Concluded on page 135)

World Markets for American Manufactures

Conducted by WILLIAM W. SNIFFIN

A department devoted to the extension of American trade in foreign lands

America's Trade Opportunity With Spain

FOR more than a decade an industrial awakening on a large scale has been manifest in Spain, which proceeded in a slow, though satisfactory manner until the outbreak of the European war. Under the stimulus of necessity arising from increased demand and the loss of usual markets consequent with the war, the movement has advanced much more actively than before. Though export difficulties have interfered with certain of the industries of Spain, nevertheless the country has been able to grasp its opportunity and not only provide for a large domestic consumption, but also to increase its important foreign trade. Under present conditions it has been impossible to import many manufactured goods of great importance, and individual initiative has to a great extent met the situation by establishing new factories and mills in Spain.

Spanish manufacturers at the present time consist principally of electrical goods, china, earthenware and glass, chemicals, textiles, paper and cork products. There are also in the northern part of Spain high-grade iron ore deposits of considerable extent. It has been estimated by engineers that they cover about 84,000 acres and contain about 400,000,000 metric tons. Only about 6,000 acres are being mined at present and in 1916 the production amounted to 4,048,564 metric tons. Difficulties of transportation, even for a short distance, have been the cause for the lack of development in certain regions and have hitherto made competition with the mines near the coast impossible. The relatively small output of Spanish iron mines is also due in part to the poor quality and inadequate patterns of the tools employed.

Many opportunities for increasing the trade of the United States in Spain are to be found. Transportation improvements are being considered for Madrid, for example which, if the plans under consideration mature, will involve heavy expenditures and require large quantities of supplies and raw materials. The United States could furnish these to good advantage. This country has in the past been a large exporter of coal to Spain and might increase the amount of its exports of this commodity if adequate shipping facilities can be obtained. Spain possesses large deposits of coal, but they have never been worked to the extent of providing for all the domestic requirements. Under war conditions, with the closing of other markets, the United States has been able to supply Spain with large and much needed shipments of iron bars, wheat, agricultural machinery, lubricating oil, crude petroleum, phosphates and machine tools. Since the war began, American manufacturers have exported also the following articles to Spain and found a ready market for them: Bicycles, automobiles, motorcycles, machinery, wheels and motors, watches and clocks, iron and steel goods, iron plates, wire, sewing machines, dynamos, carriage frames, hardware, table knives, kitchen utensils, locks, scissors, zinc manufactures, instruments (measuring, medical and musical), glassware, porcelain, hemp and hemp twine, sandpaper, sand cloth, cotton goods, ammunition, leather, soap, tallow, toys, timber, wooden piping, staves, chemicals, perfumery, tar, tobacco and notions. Produce merchants, too, have sent to Spain sugar, flour, canned beef, bacon and hams and lard.

Spanish exports to the United States, while much affected by the shortage of shipping facilities, consisted of record quantities of olives and increased amounts of sulfur oil, cork wood, garlic, goat and lamb skins, and soap, besides smaller quantities of wines, tobacco and certain minerals, such as iron pyrites, etc.

During the calendar year 1916, Spain's foreign commerce amounted to 2,664,000,000 pesetas[1] for imports and exports. The 1915 statistics of the Spanish Government (the latest official statistics available) show that the United States, exclusive of Porto Rico and the Philippine Islands, exported $53,598,356 worth of goods to Spain, while it imported from that country $11,275,220 worth. Transportation difficulties, however, contributed to make the favorable balance of trade of the United States larger than in the preceding two years. Next to Great Britain, the United States was the largest foreign market for Spanish goods.

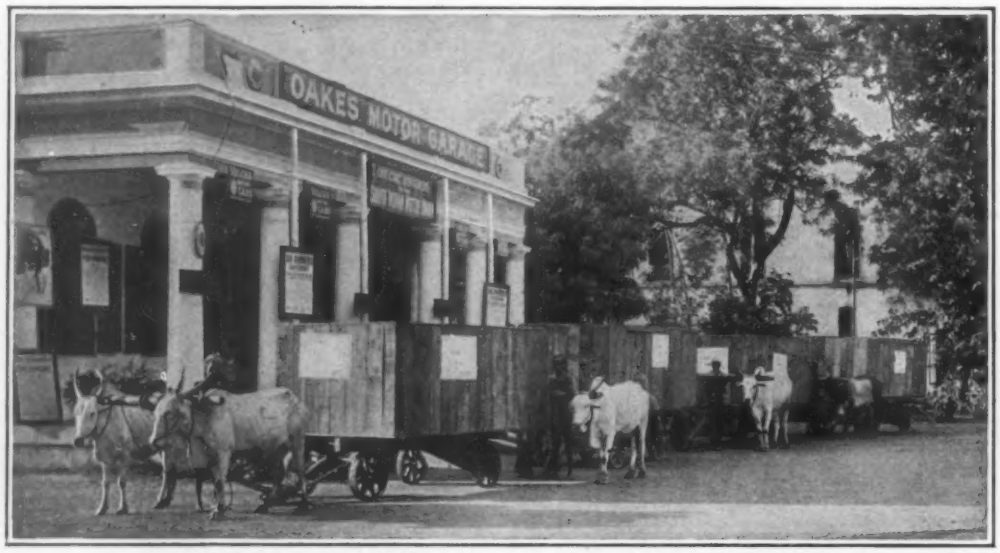
Real development of Spain's potential resources in agricultural, mining and manufacturing cannot be accomplished without the installation of modern equipment. American manufacturers should find ample opportunity for increasing their exports to Spain, more especially as after the war this market will surely be largely confined to the United States, Great Britain and Germany. It is well known that Germany has maintained large numbers of commercial representatives in Spain and, moreover, Great Britain has not been altogether inactive in that field.

Statistics recently published indicate that there are at present 60,085 factories, mills, foundries and other industrial plants in Spain, excepting those in the Vizcayan and Navarre provinces. These are distributed by classes as follows:

Flour and grain	19,091	Leather	1,810
Machinery	7,648	Cotton	1,787
Porcelain, glass, crystal and ceramic	4,629	Boilers and metal products	1,723
Oil	4,227	Textiles (exc. cotton, wool, silk and linen, exclusively)	1,427
Chemicals	3,047	Effervescent drinks	1,342
Sawmills, furniture and carpentering	2,704	Chocolate	1,173
Wines, liquors, etc	2,564	Glue and soap	1,061
Wool	2,172		

The plants are scattered throughout the whole country, but the largest number are to be found in the Province of Barcelona, 10,999. More than half of the industrial establishments of the country are to be found in the Provinces of Barcelona, Valencia, Madrid, Oviedo, Gerona, Alicante, Coruna, Badajoz, Burgos, Toledo and Seville.

[1]Peseta = about $0.20, having risen from $0.18 in 1914.



A shipment of American motor cars arriving at a garage in Madras

American Automobiles Wanted in the Far East

THE United States is at present the world's market for motor cars and trucks, and steps are under consideration by automobile manufacturers and exporters to make this position secure and to extend the sale of American motor vehicles in foreign countries as rapidly as possible. In 1917 the United States shipped abroad 64,808 passenger automobiles, valued at $48,612,632, and 15,977 motor trucks worth $42,343,502. Canada was the principal foreign market for passenger cars exported from this country during the 12 months ending June 30th last. In that period, 14,421 pleasure cars, with a value of $11,143,740, were sent from this country to Canada. The United Kingdom and France led in the purchases of motor trucks, the figures being: The United Kingdom, 6,525 trucks, valued at $17,061,105, and France, 4,264 trucks, valued at $13,854,903.

The U. S. Bureau of Foreign and Domestic Commerce has recently had an agent, Mr. Tom O. Jones, in the Far East—in Japan, China, the Philippines and Hawaii. Mr. Jones reports a prosperous condition of affairs prevailing in Japan, which is buying more automobiles, especially large cars, than ever before. There are about 2,400 automobiles in Japan at present, 600 of which were imported during the first nine months of last year, as against 218 during all of 1916. Japanese roads are very narrow and the bridges weak, but the Government is spending $2,000,000 on the road from Tokio to Yokohama, and has ordered the provinces to improve their roads and bridges. The Japanese army is using some motor trucks. Army engineers brought an American truck from Tientsin, China, and copied it at a Government arsenal, but had so much engine trouble that the idea of manufacturing trucks in Japan was given up. The Government is now buying its trucks in this country.

Owing to the unsettled political situation in China, the Chinese hesitate to buy cars now, because they fear that they may be confiscated. There are practically no roads in China outside of the cities and the foreign concessions, but the governors of the provinces are beginning to realize that their districts are handicapped on this account and propose to build roads to connect towns with the railroads. There is a 1,000-mile road from north China to Manchuria, on which two light American cars are operated on a regular passenger-carrying schedule.

In and around Peking there are about 150 miles of roads suitable for automobiles. At a conference held recently between the representatives in Peking of the Rockefeller Foundation and the Chinese director general of flood relief, arrangements were completed for the construction of the proposed model highway from Peking to Tungchow, an important provincial town about fifteen miles east of Peking. The American Red Cross has already deposited $100,000 in a Peking bank to cover the cost of this work, and the Chinese Government has promised to deposit an equal amount shortly. It is proposed to extend this road to Tientsin when additional funds are available. Thus good automobile roads are sure to become common in China, as their great economic value and meaning to the community are realized, and with the coming of good roads, of course, the market for automobiles will be definitely and steadily increased.

America's Foreign Trade Records For 1917

THE country's foreign trade amounted to over $9,178,000,000 in 1917, exports reaching a total of over $6,226,000,000, while imports amounted to more than $2,952,000,000, according to figures recently issued by the U. S. Bureau of Foreign and Domestic Commerce. This is a gain of nearly $1,300,000,000 over 1916, when the total trade amounted to $7,874,000,000. The excess of exports over imports has nearly doubled in the last two years, amounting to $3,274,000,000 in 1917, against $3,091,000,000 in 1916 and $1,776,000,000 in 1915.

December exports amounted to $589,000,000, an increase of no less than $100,000,000 over November, while the imports for December amounted to $228,000,000, or $7,000,000 more than the figure in November. Free imports formed 76 per cent of the total in December and 72 per cent of the total for the calendar year 1917.

Building Appliances Needed in England

THERE is a large market for trucks, skids and push carts at Bradford, England, but local manufacturers are meeting the demand adequately. The United States could, however, do a fair trade in wheels, brackets, castors, etc., if satisfactory terms can be offered and deliveries can be made with reasonable promptness. American wheelbarrows find favor among dealers in England, where they are usually imported knocked down. Dealers and workmen prefer that the wooden handles or shafts be hollowed out to afford a comfortable grip, as they are regularly made in England. The demand for wheelbarrows, scrapers and other articles for grading and handling earth will undoubtedly be very great in England after the war, when many large enterprises and building projects will be put into execution.

Household Labor-Saving Devices in Wales

AMERICAN household labor-saving devices—bread mixers, mincing machines, knife cleaners, floor-cleaning machines, lawn mowers, etc.—found a ready market in Wales before the war. During the past two years, however, importation of these articles has been rigidly restricted. Consequently the demand for them after the war is expected to be large. Office equipment, also such as typewriters, filing cabinets and stationery, and printing machines will be in great demand.

One of Alabama's large steam plants where coal is mined at the back door and burned on the spot to generate power for wide distribution

A Way To Enormous Coal Economies

Why Transport Fuel When We Could So Much Better Transport Power?

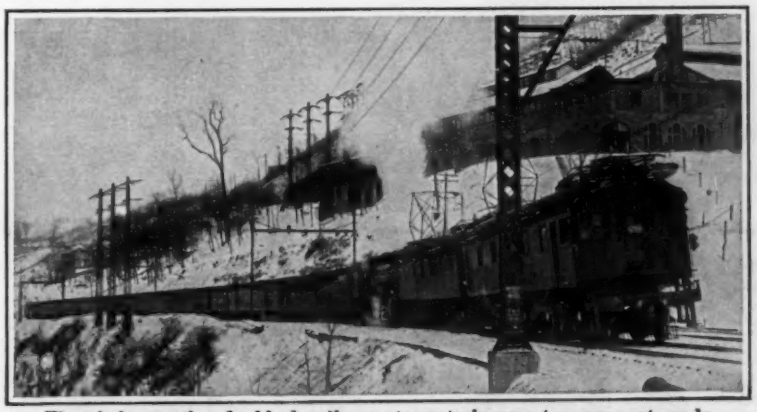
SAVING coal at a cost of $223 a ton! Such, in substance, is what a statistician has said the nation paid for the fuel conserved during the recent industrial shutdown. America, rich in its deposits of anthracite and bituminous coals; America, capable of taking from its mines more than 600,000,000 tons of coal annually and able to spare quite ten per cent of that for export; and yet the American people must shiver, business activities must limp, and many thousands of factories must close all because of a scarcity of fuel! Surely an amazing paradox in the face of nature's plenty.

The fact that the wartime administration of the country's coal stores may have been muddled; the fact that severe weather prevailed at a crucial period; and the fact that the fuel arteries of the country, the steam railways, were overburdened and congested just when coal was needed most, were circumstances that aggravated and yet only served to emphasize a state of affairs normally growing more acute from year to year by reason of obsolescent methods and nationwide wastefulness that were bound sooner or later to bring upon us a rude awakening.

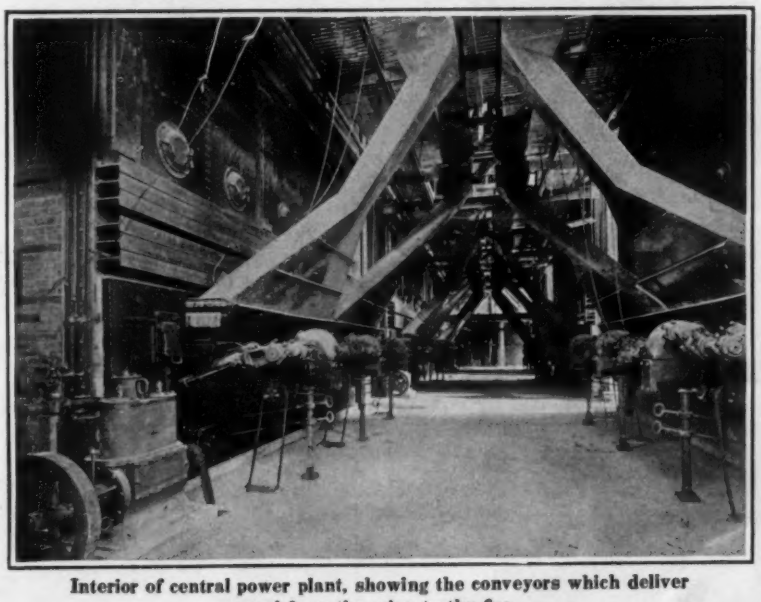
In brief, we have been spendthrift; we have been short-sighted; and we have been wilfully inefficient in the burning of our coal for a long while: faulty in all of these particulars because we have clung to out-of-date facilities and persisted in practices that have bred needlessly heavy outlays when a far better service could have been ours at a lower cost. In many parts of the United States we have been guilty for decades of virtually "carrying coals to Newcastle." That is to say, we have moved billions of tons of fuel an enormous number of miles when the energy ultimately produced by that fuel could have been generated, in a very large number of instances, and distributed to the consumer by burning the coal at the mouths of the mines. This is not a theory; it is a commercially established fact, and our present hardships may prove a blessing if our eyes generally are opened and we hasten with due speed to establish a new order of things in the utilization of our mined coal.

It is authoritatively asserted that our railroads use and carry for their own requirements approximately 190,000,000 tons of coal in the course of each 12 months. They move this coal for the purpose of developing power at chosen points, and, apart from the coal consumed by their locomotives for other services, they burn coal to move this coal. Some idea of what this traffic amounts to can be realized if we strike an average and assume that the coal cars carry 45 tons apiece—undoubtedly a generous figure—and allow an overall span of 50 feet from coupling to coupling. To transport 190,000,000 tons of coal means 4,222,200 carloads or a train 40,000 miles long! This would reach around the equator nearly one and two-thirds times. Inasmuch as our freight trains at present average only a mile an hour, counting in all stops and delays, it would take more than 4½ years for that string of coal cars to pass a single point! True, fewer cars are actually required, because each carrier does repeated service in the course of a year; but, even so, it is evident to what a large extent the railroads' fuel supply clutters their tracks.

The householders of the United States are said to burn annually something like 135,000,000 tons of coal, and the U. S. Bureau of Mines has stated: "Probably 10 to 15 per cent of the coal produced in this country goes to purchasers who use it largely for heating dwellings." That is to say, there are moved by the railroads approximately 90,000,000 tons of coal every year for the foregoing purpose. It would seem that coal for cooking and heating water for general domestic uses averages the country over about 50,000,000 tons. In other words, over a million carloads of fuel are required mainly for culinary purposes, or a total of 3,000,000 carloads for general domestic needs of every description.



Electric locomotive double-heading a steam train up a two per cent grade at 28 miles per hour. In the background the section power house



Interior of central power plant, showing the conveyors which deliver coal from the mine to the fire

Finally, our industrial plants, our business buildings, our public service corporations that furnish light and electrical energy, and our steam-propelled shipping, call for substantially 220,000,000 tons of coal. This means a yearly movement, of these activities, of 4,890,000 carloads of fuel. It is probably not an exaggeration to say that quite half of these consumers of fuel are so placed that they could be furnished electrical current for power and illumination from central stations, if a goodly percentage of them are not already being supplied in this manner—the central stations, however, being in the majority of cases in the immediate neighborhood of their subscribers. Therefore, the coal required has to be transported by rail for considerable distances. While the actual carriage is at a relatively low cost, the final charges are greatly increased by handling and distribution at the terminal points—outlays that are utterly disproportionate in view of the service performed and the distances covered to effect these final deliveries.

The outstanding feature of this problem is that about 12,112,200 carloads of coal are sent broadcast over the country in the course of a year to meet our various native needs, whereas by the adoption of efficient and thoroughly modern methods of generating energy and providing gas for cooking, etc., it would be practicable to reduce this coal movement approximately fifty per cent, to just that extent lessening railway congestion and obviating the distress and difficulties we are now battling with because of a shortage of coal at the points of greatest consumption.

The Department of the Interior has made this startling assertion, covering the fiscal year that ended with the 30th of June, 1917: "Last year the people of the United States burned some 500,000,000 tons of coal. If this coal had been used with the highest efficiency, it is probable that some 125,000,000 tons, or 25 per cent, would have been saved. . . . Large turbo-generating units and efficient boilers are now available that return, as useful electric current ready for distribution, nearly 20 per cent of the potential energy in the coal. Against this, the average efficiency of all kinds of steam-power plants in the United States is somewhere in the neighborhood of 5 or 6 per cent of the energy of the coal, transformed into useful energy ready for distribution."

The logic of this is that engineering science has forged so far ahead that the best applications of its knowledge far outstrip the general state of steam production and power generation the country over; and if the coal burned were efficiently consumed at the practicable maximum, then every pound would yield fully three times its present average output in energy. This is essentially the age of electricity, and energy in this form is the most flexible one for conversion into power or light to meet the multiple services demanded by our vast range of business, industrial, and social activities. Mechanically, the turbo-generating unit is the one best suited to provide large volumes of current with a minimum consumption of coal. There are turbines in service today having individual capacities of 30,000 kilowatts that call for but 1.5 pounds of coal per kilowatt hour, and there are turbines now building of 70,000 kilowatt capacity for which greater economies are promised.

It is manifest that coal saving grows proportionately with the magnitude of the generating units and the number of these operated by a single steam plant. Therefore, we have in this fact confirmation of the material economies that result from one power station which is capable of furnishing the aggregate output in energy of numerous isolated plants. Not only that, but large central stations actually cost less to construct, per unit of output, than the smaller isolated plants; and, finally, the labor charges are correspondingly lower, because the

(Concluded on page 139)

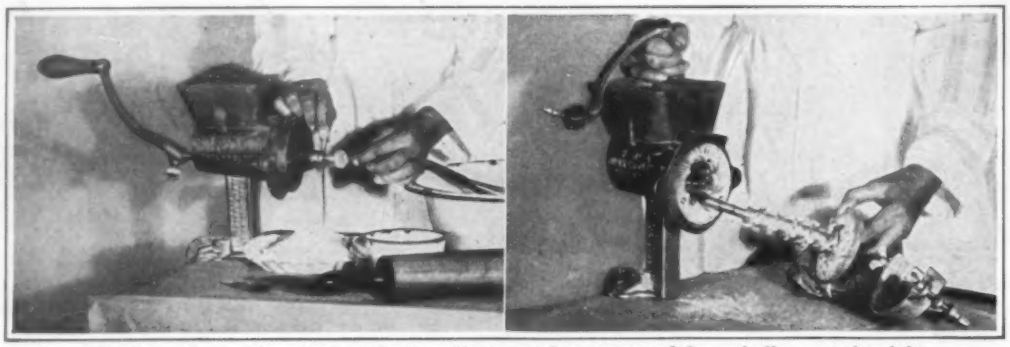
Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Wheat and Corn Grinder for Home Use

By Fred Telford

OF the many measures of food conservation proposed, by no means the least important is the use of whole wheat flour and whole corn meal. All health authorities are agreed that valuable mineral products, found in the outer portion of the grain and carefully sifted out in the modern milling process, are essential in the maintenance of health; and these remain in the whole grain products. They also call attention to the fact that by using whole wheat flour and whole corn meal a large part of the grain which would otherwise be fit only for animal food is made available for human consumption; in the modern process about one-fourth is rejected.



The home flour mill. At the left, the adjustment for coarse and fine grinding; at the right, dismantling the machine for washing

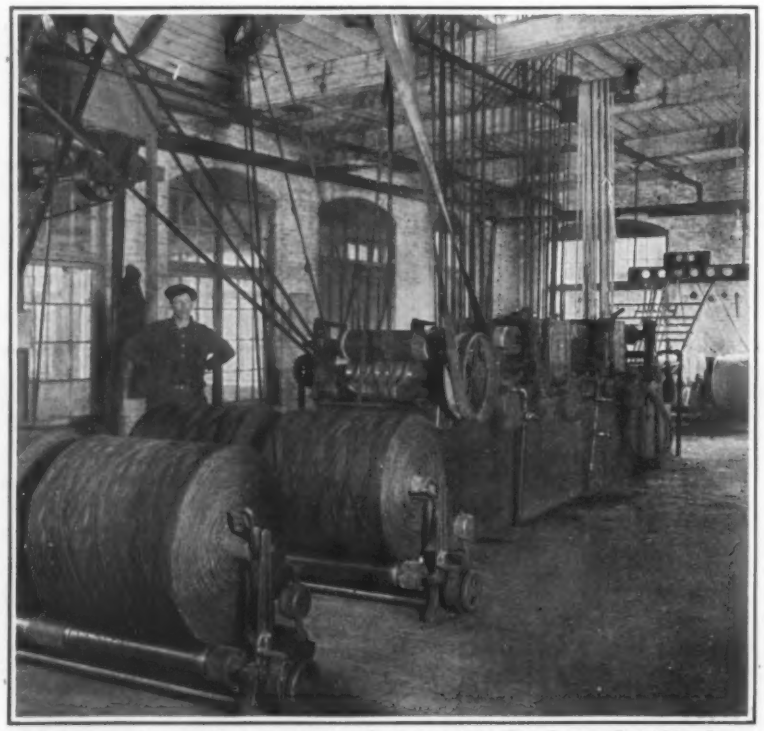
The housewife desiring to use whole grain products, however, finds difficulties in the way. Often the dealers do not have them in stock. Still more important, they may be wormy or rancid; in summer in particular worms attack whole wheat flour, while a high temperature soon turns the fat from the germs rancid. In addition, there is danger of adulteration; many products purporting to be from the whole grain in reality are not.

All these objections are overcome by means of a small, easily operated, inexpensive grinder with which the housewife may make her own flour or corn meal in the home from the grain. A quart of flour, for instance, may be ground from wheat in 15 minutes just at the time it is needed; thus all danger of adulteration, rancidity, or worms is absolutely eliminated. Also, since either corn or wheat can be secured in the open market at moderate prices at any time, so the housewife becomes independent of the profiteer in food products.

In appearance the grinder is much like the ordinary food grinder. It is clamped to the kitchen table or other support in the same manner, and operated by turning a long handle. The mode of operation is so simple that there is little possibility of going wrong. The wheat or corn is placed in the hopper, the handle turned, and the flour or meal comes out at the other end. Adjustments to secure a finer or coarser product are made by turning a small lever to a vertical position so that a thumb screw may be turned. The parts are easily taken out for washing so that the machine may be kept clean and sanitary.

The grinder may also be used for grinding other grains such as rye and barley. It is especially useful in families with children for making peanut butter. In grinding nuts the crusher used for grains is removed and a worm feed substituted.

The grinder costs less than $5 retail. Each purchaser is given a booklet containing many recipes for whole grain products. In general the proportions and amounts are not much different from those in ordinary use, but with exact directions the highest degree of economy and palatability are assured. A large variety of toothsome dainties can be made from the whole wheat and corn products; actual tests show that they are more satisfying to the appetite than those made from white flour and corn meal, agreeable in flavor because of the more pronounced taste, and slightly laxative in effect because of the presence of waste materials that give bulk.



Where raw yarns go in at one end and come out dyed and wound at the other

Rapid-Fire Dyeing

IT is always of passing interest to chronicle a new conquest by the ideal represented in the phrase "one continuous and automatic operation," an ideal which is in large measure responsible for the great industrial development of the twentieth century. Thus, where formerly we had to feed single sheets of paper twice into a press and remove them each time, turning them over between the two printings, then carry them to a folder, put them through this, and finally stack them on a table and count them, we now increase our output a hundred fold by inserting the end of a roll of paper into the jaws of a web press, which performs all these operations automatically, in their order. Similarly, in factories turning out large quantities of identical metal parts, the use of half a dozen different lathes, drills and planers, each with its own operator, each demanding that the work be brought to it from one of the others, has gone out before the specially designed automatic machine which receives a rough chunk of metal at one end and turns out a finished binding post or thumb screw or valve collar at the other.

We illustrate a rather novel application of this principle which has just been worked out and patented by a Connecticut textile concern specializing in blue yarns. The photograph almost speaks for itself. In a continuous "run" through the apparatus the white yarn is boiled and cooled, passed through two compartments of indigo, washed, and wound on reels. Not only does this process save $15 a day in labor and effect an economy of six per cent in the color used, but it has practically eliminated breakage of yarn in process, and has if anything improved the quality of the finished product. Its capacity is 12,000 yards of yarn per day.

First Aid to the Circus

KEEPING a circus on time—hauling the tents down and making the jump to the next town in less than twelve hours—is no small amount of work, especially if the night be rainy and the next show town a long distance away. An invention that is calculated to save from one to six hours of work every night is a revolving tent wagon, built by W. H. Curtis of West Baden, Ind. Two circus companies have used the invention the past summer, and so successful have the results been that several others are having machines built this winter.

The usual method of handling circus tents is to fold them up into bales, load them on wagons for the night, and in the morning unroll them again. By the new method they are wound on huge spools each evening and the next morning simply unwound from the reels again. The tent-winding machine consists simply of this spool, 25 feet long, mounted on a wagon. The spool is turned by means of a gasoline engine mounted at the back of the truck.

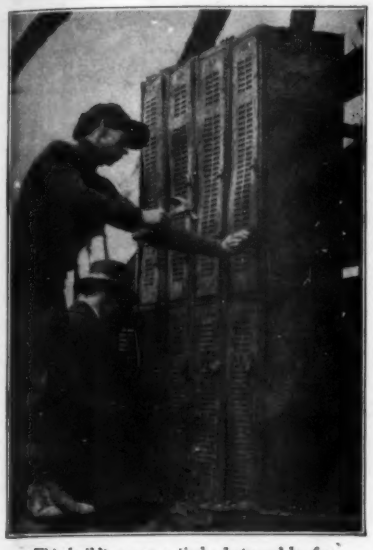
Circus tents are made in 50-foot sections and so it is

(Concluded on page 140)

The main tent of a big show being packed by winding it on the huge spool

Front and rear views of the wagon upon which the circus tent is now wound

DURAND
Steel Lockers



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Thirteen-foot Model of the World's Most Active Volcano

(Concluded from page 132)

preserved. The blocks near the Volcano House (hotel, *1*) are particularly instructive.

Near the foot of the Uwekahuna cliff is the only intrusive mass of lava so far discovered in the district. It is a flat-lying lens (*3*), nearly 450 feet long on the cliff's face and about 60 feet in maximum thickness. When molten, this body was forced horizontally into the older lava beds. The injected lava, slowly cooling under the cover of several hundred feet of solid rock, has crystallized with coarser grain than that characterizing superficial lava flows. After the mass was thus consolidated, the eastern part of it, together with the enclosing lava flows, foundered. The fractured lens, of light gray color, thus became exposed in the wall of Kilauea sink.

East of the main sink are shown four apparently extinct pit-craters. The largest is Kilauea Iki (Little Kilauea, *11*), floored with a lava lake which was frozen before the first visit of a white man, in 1823. This crater is nearly 800 feet deep. The pit called Keanakakoi (*10*) is said to have been active in 1877; its whole floor was then occupied by "a bubbling, boiling mass" of basaltic lava. The other two pits (*9*) have no record of activity, either in written history or in native tradition.

Though Halemaumau is ordinarily the least dangerous of the active vents of the world, it has been the scene of one violent explosion, generally attributed to the year 1789. Large volumes of ash were thrown out and now form a thin veneer over several square miles of the older lavas around the sink. Wet-weather streams have already furrowed the veneer with many shallow valleys best exhibited to the south of Kilauea.

Southwest of Halemaumau, several wide cracks (*7*), which were opened in the older lavas during strong earthquakes of 1868, are modeled. The system of cracks may be followed 15 miles to the southwestward.

Fumaroles, from which hot gases are emanating, are found at some points. Deposits of sulfur and of various salts are registered by light-tinted areas just west of the Volcano House (along a fault fissure), and on the dark floor of the sink. The reader will note especially a white fumarole (*4*) in front of Uwekahuna cliff and a narrow, nearly circular band of fumarolic deposits around Halemaumau crater. The band (*6*) corresponds to an actual encircling fissure, along part of which a slight movement has occurred, as if the summit of the Halemaumau cone were itself beginning to subside.

The center of interest, alike for tourist and man of science, is, of course, the active crater, Halemaumau (*5*). The grandeur of its restless lake of "boiling" lava cannot be even suggested by any artificial means, nor is it fully apparent until one views this living thing at night. More vividly than at any other spot on the globe, the observer gains the impression that the earth is a crusted star, now only quite locally incandescent at its surface, but certainly very hot within. The level of the surging lake is shown in the model as it was at a certain day in 1913—about 400 feet below the crater rim. For ten years, beginning with 1907, the crater has been active and the level of the molten lava has almost constantly shifted, alternately up and down. At times the lake level has risen nearly to the crater rim; at other times it has sunk even lower than it was in 1913. The rough terraces around the inside of the pit represent successive shore lines of the lake after long, slow sinking.

The Kilauean vent has undergone another systematic change since it was first seen by a white man. For prolonged periods during the second quarter of the nineteenth century, the lava lake occupied a much larger part of the sink floor, so as to be 200 to 300 times larger than it was in 1913 and at least 20 times larger than at any time in the twentieth century. If the past is the key to the immediate future, a few decades may see Halemaumau become as lifeless as Kilauea Iki. That is one of the reasons why the intensive study of

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RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangements with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

GARMENT.—E. V. HIGLEY, 13 Lincoln Ave., Glen Falls, N. Y. The invention relates to children's wear, the main object being to provide an underwaist designed along scientific lines whereby the weight and strain of the garments, and the strains due to physical action on the part of the wearer, will be taken by bands leading over the shoulders of the wearer, and not upon the fabric of the underwaist.

VEST.—M. STANGER, 15 West 26th St., New York, N. Y. Among the objects of this invention is to provide a chest protector or bandage adapted to be worn around the chest somewhat in the manner of a vest or jacket, the same being provided with one or more plies of material including a ply of material impervious to air or water, the invention provides a device adapted to be worn by an individual of either sex.

SANDAL.—I. GOLDSTONE, 5922 Eighteenth Ave., Brooklyn, N. Y. The object of the invention is to provide a sandal having a sole of rigid material, and to render such a sandal comfortable by forming the sole of relatively movable sections, the front section and the rear section being united by a flexible member; the two sections are provided with straps and a lace for tying about the foot.

Of General Interest

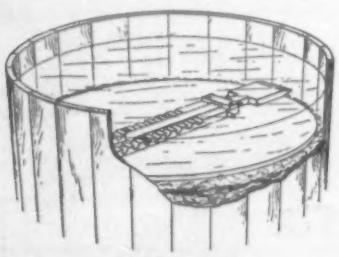
LAVATORY.—M. J. CARROLL, R.6, 88 Broad St., Elizabeth, N. J. The object of the invention is to provide a lavatory arranged to deliver the water to the bowl without danger of splashing the water about. In order to produce the desired result use is made of a bowl having a passage formed in the rim and having an inlet opening connected with a water supply, the passage having an outlet channel opening onto the inner face of the bowl.

PLATFORM FOR STAIRWAY.—S. LIBERMAN, 802 W. 181st St., New York, N. Y. The invention relates to metallic building structures, its object is to provide a new platform for stairways, arranged to dispense with supporting T-irons and sockets, and to permit of economically manufacturing and setting up the platform and at the same time providing a trussed platform which is exceedingly strong.

LAP TABLE FOR STEAMER CHAIRS.—R. A. LARSON, 624 Vanderbilt Ave., Brooklyn, N. Y. Among the principal objects which the invention has in view are: To provide an auxiliary member which may be converted at will into a table or rest for a steamer chair, without relinquishing the leg rest to provide a member of this character which may be folded within small compass on the leg rest, and to provide a support which may be used for locking the lap table in the position where it is folded on the leg rest.

HANDLE FOR POCKET BOOKS.—B. FISCH and J. WALDMAN, 487 Cleveland St., Brooklyn N. Y. The object of the invention is to provide a handle combining a main tight handle and a long loose auxiliary. The main handle is secured at its ends to the pocket book, and two sleeves are slidably mounted on the main handle to which the ends of the auxiliary loose handle are secured. The auxiliary is disposed flat against the main handle when the latter is used.

BARREL CLAMP FOR FOLLOWERS.—J. T. DORAN, 308 15th St., West New York, N. J. This invention relates to clamping devices for holding the contents of barrels, casks, vats or any form of tank under the brine or liquid to prevent spoilage, the device is adapted to be used in connection with followers in receptacles containing sauerkraut pickles, cornbeef or anything requiring a covering brine or liquor, the device presses gently against the contents for causing them to remain submerged.



PERSPECTIVE VIEW OF A BARREL SHOWING CLAMPING MEMBER APPLIED

CLOTHES LINE SUSPENSION.—F. A. SCHUREMAN and W. J. KELLY, 342 Sixth Ave., Brooklyn, N. Y. Among the principal objects of the invention are, to enable the laundress to place articles of clothing on a pulley line without leaning out of the window or otherwise placing herself in a dangerous position, to enable the laundress to lock the clothesline in working position without the expenditure of great effort, and to multiply the effectiveness of the drying apparatus without materially increasing the cost.

LIFE BOAT HOLDING AND LAUNCHING DEVICE.—F. W. SIEVERS, 815 St. Johns Place, Brooklyn, N. Y. This invention has for its general objects to provide a device which is of comparatively simple construction and so designed that the lifeboat can be launched with a maximum dispatch and minimum effort. A more specific object is to provide a simple means for releasably holding the lifeboat on its truck in such a manner that the boat is normally rigidly supported but which can be readily unlocked and released.

VEGETABLE GLUE OR ADHESIVE.—R. W. TUNNELL, 15 N. 5th St., Philadelphia, Pa. The object of this invention is to provide an adhesive suitable not only for laying wood veneer but for making satisfactory glue joint work, where adhesive can be applied mechanically to wooden joints. The composition belongs to that class of adhesives of vegetable origin produced from starch which has been modified or hydrolyzed by the action of acids on the aqueous solution, preferably in the presence of heat. The process consists in treating the hydrolyzed starch with alum in excess of caustic alkali to form an alkali aluminate.

TELEPHONE RECEIVER.—A. POLOUMORDVINOFF, Petrograd, Russia. The invention comprises a telephone receiver, having an oscillating polarized armature, a membrane, connections between the membrane and the armature for vibrating the latter, the connections comprising wires secured to the ends of the armature, the opposite ends being secured to rigid supports, and branch wires secured to the first named wires and to the membrane.

PERPETUAL CALENDAR.—G. V. HOUSE, 757 Broadway, New York, N. Y. The invention provides a calendar arranged to enable the user to adjust or set the same quickly and easily for a whole year of any one of the years of the Christian era under either the Julian or Gregorian systems, the calendar when set for such use displaying the month of the year, the days of the month, and the names of the week days in proper relation.

Hardware and Tools

COMPASS.—P. MILLIKEN, Elsinore, Cal. The invention has for its object the provision of a compass having a cross-head at an angle to the elongated body and with a guide slidable thereon,

COMPASS

it being possible to use the compass to produce loci and divide angles. The compass may be used to divide circles and arcs into any number of equal parts, and to describe all regular polygons.

TOOL HOLDER.—J. B. PERRY, Box 377, Oakland, Cal. This invention relates to a holder for tools used in connection with percussion hammers. An object is to provide a holder which will facilitate the retaining of the tool at the hammer and also protect the hand. The device is in the shape of a hollow cone frustrum having slits at the narrow end for rendering the end yielding and a jacket of heat insulating material to facilitate the handling of the holder.

Machines and Mechanical Devices

ROD PULLING MACHINE.—A. E. GILBERT, 618 N. Boston Ave., Tulsa, Okla. The invention relates particularly to a machine for withdrawing the sucker rod from drilled wells, it consists in a pair of rod clamping members arranged one above the other, the lower one being mounted in connection with a frame engaged with and supported by the well casing, and upper one being suspended from a cross bar, the latter of which may be hung onto a jack beam or the like for raising and lowering.

PRESS FOR TESTING THE BASES OF ARTILLERY SHELLS AND THE LIKE—E. DECAUVILLE, 248 Rue Lecourbe, Paris, France. The invention relates to a device for testing the pressure capable of being supported by the bases of shells, various apparatus have been invented to press the base of the shell against the bed of the press. The present invention is characterized by the fact that the pressure of the shell against the bed of the press is exercised through the medium of a liquid.

WIRE WINDING MACHINE.—C. L. VAN AMBURGH, address W. E. Russell, 708 N. Ainsworth St., Tacoma, Wash. The object of the invention is to provide a winding machine more especially designed for winding a wire helically around a stave pipe while the latter is being assembled in a ditch or other place, allow of conveniently placing the machine in position at any point in the length of the pipe, or removing it when desired.

WHEEL RIM EQUALIZING AND JOINT FORMING MACHINE.—G. A. ENSIGN, and H. D. TRAUB, Defiance Machine Works, Defiance, Ohio. The object of the invention is to provide a wheel rim equalizing and joint forming machine arranged for cutting off the ends of an approximately semicircular wheel rim stock to reduce the latter to a true semicircular shape and to form joints on the ends of the stock to permit of joining two rim sections in an accurate manner.

WALL PAPER MACHINE.—E. C. BAECK, 130 N. Broadway, Irvington-on-Hudson, N. Y. The invention relates to machines for printing wall paper. An object is to provide a machine whereby a highly ornamental effect on the wall paper is produced with the use of simple and comparatively inexpensive means and without the use of cut printing rolls.

Prime Movers and Their Accessories

TRANSMISSION MECHANISM.—J. W. MURRY, 303 Mortan Ave., Moundville, W. Va. The transmission means patented by this inventor is of the friction-disk type, whereby the relative speeds of the drive shaft and driven shaft are varied by the shifting of the friction disks on the one shaft over the faces of the disks on the other shaft and relatively to the centers of the latter. The device employes a series of electromagnets adjustably mounted and acting to bring about an effective driving contact between the disks.

Railways and Their Accessories

MAIL BAG CATCHER.—C. B. DAVIS, address J. L. Davis, 7252 University Ave., Chicago, Ill. An object of the invention is to provide an automatic mail bag catcher which is so arranged that after it has once been set by the mail clerk, no further attention need be paid to it, thus obviating the necessity of standing by the mail bag catcher and "sighting" it at a mail suitably supported at a way station. The invention is interchangeable from one side of the car to the other, and when out of use lies against the side of the car.

Pertaining to Vehicles

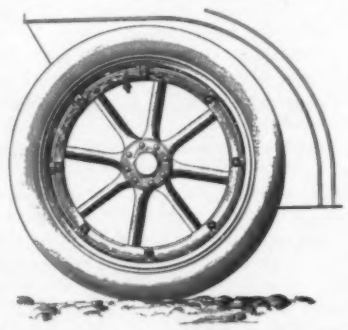
ELECTRIC LAMP ATTACHMENT.—C. SCHICKERLING, 511 Union Place, Union Hill, N. J. The invention relates to electric lamps such as are designed for headlights. Among the objects is to provide an electric bulb which is so designed as to cut off or reduce the effect of objectionable light rays which tend to produce a glare from the upper portion of the light, and to produce and intensification of the light that is to be thrown downwardly upon the roadway.

TRAILER ATTACHMENT FOR AUTOMOBILES.—P. A. WOOD, Room 138, House Office Bldg., Washington, D. C. An object of this invention is to provide a trailer which may be attached to the chassis of an automobile, so that it may be drawn thereby, means being provided for turning the wheels of the trailer so as to steer the latter and thereby prevent the skidding of the trailer due to the momentum of the latter and its load when turning corners, and means for permitting the vehicle to turn in less space than would ordinarily be required.

SIGNAL LAMP FOR VEHICLES.—C. P. HEPLER, Salem, Ohio. The invention relates to signal lamps for vehicles such as automobiles. An object is to provide a rear signal which will indicate the slowing down or stopping of the vehicle, and which will also indicate the forward movement of the vehicle when the latter has attained a predetermined speed, the device is connected with the driving mechanism, and works automatically without any attention on the part of the driver.

ANTI-SKIDDING DEVICE.—I. HARRISON, 432 Wood St., Pittsburgh, Pa. The invention relates to protecting devices and anti-skidding devices for automobile tires, and has for an object a construction which may be quickly applied and removed. Another object is to provide a device so formed that it will not wear or in any way injure the tire, the device is formed with a pair of spaced protecting members and a removable anti-skidding device arranged between them.

SECTIONAL DEMOUNTABLE RIM.—J. L. MAGUIRE, care of John F. Brown, Attorney, Elkins, W. Va. One of the principal objects is to provide a sectional demountable rim for automobile wheels, having features for locking the sections of the rim together and for centering the sections relatively to each other before the locking action takes place. The device is simple durable, efficient in operation, and inexpensive to manufacture.



SIDE ELEVATION OF AUTOMOBILE WHEEL EQUIPPED WITH THE INVENTION

TIRE TREAD.—J. BLAIR, JR., 102 2d Street, Rock Springs, Wyo. The present patent is a division of an application filed by the same inventor March 7th, 1917, serial No. 152,988 and relates to tread elements and means to mount the same on a tire. The tread is more particularly intended for application to a protective shell as set out in the aforenamed application.

AUTOMOBILE FRAME EXTENSION.—W. N. SHANNON, 396 Classon Ave., Brooklyn, N. Y. The invention relates to automobiles and has particular reference to means for transforming an ordinary pleasure car of standard type into a commercial vehicle with an extended chassis. Among the objects of the invention is to provide means of a simple, reliable and easily manipulated nature for the above purpose.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

the safest, most instructive of volcanoes should be pushed with all possible speed. The scientific world is indeed fortunate in possessing a wonderfully close representation of 1913 conditions at a volcanic center which has been changing so drastically during the last hundred years.

Already geologists have reached some ascertained principles or highly probable conclusions bearing on the origin of the features depicted in the model. The history of the main sink and the pit-craters is necessarily connected with that of the whole island of Hawaii. Around the island the Pacific is about 18,000 feet deep. Mauna Loa and Mauna Kea, the culminating points of Hawaii and each nearly 14,000 feet above sea-level, are the highest volcanoes in the Pacific. All the available facts suggest that the composite pile, thus more than 30,000 feet in height, has been slowly built up by successive outflows of lava from a few centers, of which Mauna Loa is the chief. Interbedded with multitudes of such thin lava flows are subordinate layers of volcanic ash. The crater of Mauna Loa, 9,000 feet higher than Kilauea, is periodically active, on a scale yet more magnificent than Kilauea itself, yet operating by an essentially similar mechanism. Through ages the mighty growth continued until the erupted mass measured nearly 4,000 cubic miles of lava above sea and ten times as much below sea-level.

For reasons not yet demonstrated, hot gases from the earth's interior then began to emanate through the older lavas in the Kilauea district, on the flank of the largely submerged pile. The issuing gases have melted vertical pipes through the older lavas. Doubtless new molten lava has also risen in the pipes. The remelted material of the older lava-beds has sunk away into the pipes and mingled with the new lava. At irregular intervals, cracks have been opened in the pipe walls and the lava has been drained away into subterranean chambers or into channels leading to the earth's surface at levels well below the tops of the pipes. With the removal of material from the pipes came a partial failure of support for the older rock-layers at the surface, with resulting subsidence, block by block, around the pipes of Kilauea and Kilauea Iki.

Such, in brief, is the probable explanation of the main sink and of the simpler pit-craters. All the vents except Halemaumau have become cold and inactive because of the exhaustion of fluxing gases from the underground source of supply. At Halemaumau the very hot gas still issues, explaining the surge of the lava billows in the molten lake.

Even though at its initial stage, the thorough study of Kilauea has already yielded facts of unequalled importance for general volcanology. Among the fundamental questions of that complex science are those referring to: the nature of the gases so largely responsible for volcanic action; the actual temperatures characteristic of vents; the sources of the heat; the relation of surface water to volcanism; the system of circulation in pipes of molten lava; and the origination, periodicity, and extinction of volcanoes. It is safe to say that, for the student of such problems, the Kilauean vent is more eloquent than any other. As its investigation continues, the value of a speaking likeness of the region, to be closely studied even by those who never reach Hawaii, will steadily increase. All men interested in Earth's mysteries must feel grateful for this masterpiece of scientific record.

Our Enemies in the Air

(Concluded from page 133)

earth it would not help men to fly." Altitude recorders are made to register up to 17,000 feet and speedometers up to 125 miles per hour on the new German airplanes. Types are quite numerous and highly specialized for their different tasks such as reconnoitering, artillery control, bombing, and chasing.

In November, 1915, all German warplanes were equipped with wireless telegraphy. The apparatus employed weighs 70 pounds and has a range of 50 miles. It transmits and receives equally well; in

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truth, this probably explains the secret of the maneuvers in squadron formation of the German raiders over England, particularly in the latest raids. The reception of wireless messages aboard the noisy airplane, as is well known, is most difficult; but the Germans appear to have solved the problem with the "Makrophone," a device which highly intensifies the sounds in the receiving telephone and makes them clearly audible in spite of the engines, vibration and wind.

The generator employed with the wireless equipment is put to good use during cold weather or when flying at great altitudes in heating resistance wires woven into the aviator's clothing. Thus he is kept warm and in full possession of his faculties, even in the paralyzing cold of high altitudes, which penetrates the heaviest wraps.

Some German raiders carry bombs of over 600 pounds weight. In the sighting of bomb hits the Germans have made continual progress, and today they are employing highly efficient sighting instruments made by such well-known optical concerns as Zeiss and Goertz, which have enlisted all their skill in this direction as well as in aerial photography.

The latest German bomb sights embody only one new principle in advance of what was demonstrated long ago by Lieutenant Scott; but they are most ingenious in the matter of mechanical computations, and in this respect not unlike the cash register. Thus sighting becomes simplicity itself. The air bubble of a fluid level is optically made to appear as a slender dark circle in the field of sight, and the marksman has only to point his long telescope so as to keep this ring central in the field and surround his target to know that the telescope points in the direction of gravity, or truly vertical. But this single vertical telescope is also made to sight objects at an angle ahead or sidewise, by means of a universally-jointed prism next to the lowest lens. This prism is operated by a mechanism next to the eye-piece, which registers on a dial the number of degrees that the prism has bent the line of sight. Sighting the same objective first at an angle and then vertically, after making an altitude adjustment, shows the speed over the ground on a chronograph. That reading, deducted from the reading on the propeller's revolution counter; the speed of the head wind—exact bombing must be done dead against the wind; the altitude as given by the barometer, minus the altitude of the target above sea level, enables the marksman to read from a table what angle corresponds to these three particular figures and by which he must sight his target ahead through the prism at the moment of the bomb's release. The new principle, therefore, is the consideration of the wind's speed and drift, though with heavy bombs of proper shape that is not only the most uncertain, but also the smallest factor.

There is one German optical device which might shed some light on the efficiency of the "aces" Immelmann and Boelke and their emulators—a "photographic machine gun" which is employed in aerial sham battles and which takes a photograph of the attacked machine at every shot, showing by its position in the field of sight exactly how each shot if real would have hit or missed.

Another German device is the air scout's "artificial eye." This is a double, stereoscopic camera of the utmost power and sharpness, built into the body at a point where, superior to the human eye which is placed behind the propeller, motor and front planes, it commands an unobstructed view of the ground below. This camera has to be stereoscopic for the same reason that our eyes are stereoscopic in order to reveal the true nature of things. With its powerful lenses it discovers, from an altitude of two miles, whether the trenches it snaps are actual or only shallow forgeries. Sham batteries are likewise detected; for this camera shows everything in true relief as against the usual flatness of photographs. This camera also permits the air scout to photograph the whole territory flown over in a continuous series of pictures.

At the recent inspection of the German air fleet by German journalists, firing from airplanes with machine guns and with small one-inch semi-automatic cannon was also demonstrated. The machine guns use the "tracer" bullet, which leave a luminous wake behind them. Incendiary bullets, too, are used, and during the demonstrations a number of targets were set on fire by these phosphorous missiles. Steady improvement has resulted in a high degree of reliability in German aerial armament; so much so, in fact, that failure of mechanism during actual combat is the exception rather than the rule, in sharp contradistinction to the early days of the war.

A Way To Enormous Coal Economies

(Concluded from page 135)

big stations make it practicable to install coal handling and mechanical stoking apparatus that cut down manual effort to a minimum.

Some years ago, the industries of Alabama were well nigh entirely dependent upon individual steam power plants—nearly all of them comparatively small. Among these were the collieries of the State. The mine operators were satisfied that they could burn their own coal for power purposes of various sorts far cheaper than they could buy electrical energy for the same services. Today, they have ceased to utilize their own fuel and they are buying current from a great public utility which, by the way, is producing, during the dry season, a large measure of its energy at steam plants—the biggest of which gets its fuel at its own back door right at the mine shaft a few hundred feet away. Water-power is the mainstay for this far-flung system during most of the year.

Up in the Scranton and Wilkes-Barre coal regions of Pennsylvania there are now installed kindred steam-power stations which distribute electricity to the neighboring coal mines and on to Bethlehem to the monster steel works, etc., located there. The coal operators find they can save money by buying current instead of using the coal they mine in their own power outfits. The central stations just mentioned are burning culm, so long considered refuse, of which there are immense piles containing many millions of tons. By reason of chain grates and other special equipment, this granular or powdered fuel can be burned very efficiently, and as its combustion is extremely rapid and well nigh complete the resulting heat is intense. Culm, at the mine, brings ordinarily about ten cents a ton, and no coal delivered at any of our manufacturing centers or cities sells for less than $3 a ton.

The Norfolk and Western Railroad has a section of its line running right through a famous coal region in West Virginia for a distance of something like thirty miles. Physical conditions forced the road to abandon steam propulsion even though having at its command locomotives of the most modern and powerful types. It decided to resort to electrification and to burn its own coal for this purpose at a single big central station. The electrical service has proved a revelation, and 12 electric locomotives are doing today a volume of service that could not be handled before by 34 Mallet engines of the well-known monster freight type.

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He Smashed a Dream

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point to their ultimate effect, they show that there is absolutely no technical reason why great power plants should not be located, in the absence of available water-power, in the heart of our various coal fields, and there generate at the mine mouth electrical energy for distribution over zones having a radius of four or five hundred miles. The coal burned in a locomotive is only half as effective in the production of power as the same fuel burned in a large stationary unit. Not only that, but the stationary plant can use a much lower grade of fuel than it is possible to consume in the furnace of a locomotive. As was recently said by an expert, "There is no reason why the power plants of Philadelphia, New York, Baltimore and the neighboring industrial communities should be located in those places; they should be placed in the Pennsylvania coal districts, and every one of the inter-linking railways should obtain their energy from the same sources."

Gas for cooking, heating, illumination, etc., should be made in the coal districts, and, like natural gas, pumped hundreds of miles to the consumers. There is no reason why coal should be carried long distances to local gas plants, when like electrical energy, it can be produced a great deal more cheaply at the source of the fundamental raw material. With our railways electrified, with current distributed broadcast through a network of lines to meet the needs of hundreds of services, our railroads would be relieved of an enormous burden and the public weal in many ways advanced.

First Aid to the Circus

(Concluded from page 136)

only necessary to fold them over once to put them on the spool. The tent section is fastened to the spool, the engine started, and it is quickly wound up. The next section is attached to the first and then wound up in the same way. This is repeated until seven tons of tents have been placed on the reel. One or more tent wagons are used, depending upon the number of tents. When all of the tents have been taken care of, the wagons are placed on the train and taken to the next town. In the morning the tents are dragged from the reel by a team of horses. Since they have only been folded once, it is an easy matter to spread them out. Of course a regular order of loading and unloading is followed, and the tent wagon is pulled by horses to each spot where it is desired to gather up or unload one of the tent sections.

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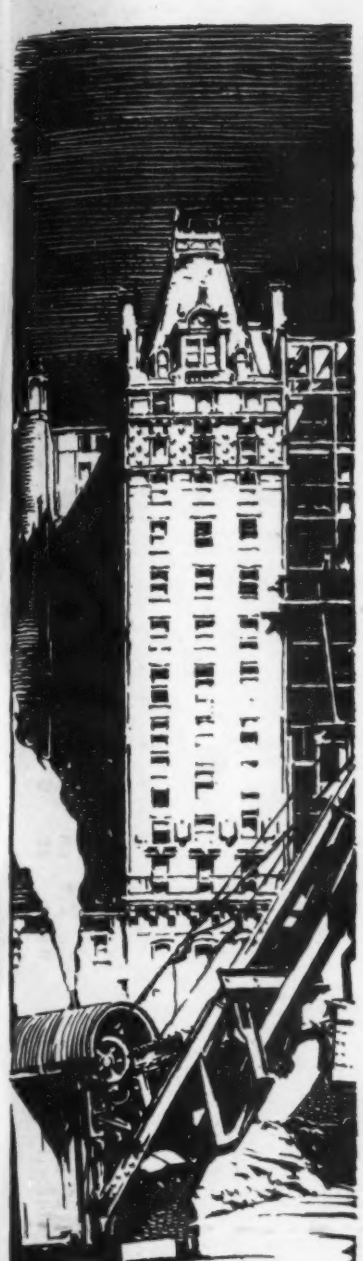

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Motor Trucks

THE PIERCE-ARROW MOTOR CAR CO.
BUFFALO, N. Y.

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The fact that Fatimas, in spite of their low price, are actually the most popular cigarette with so many of these men, is a pretty good indication that Fatimas offer something extra in smoking-pleasure that no other cigarette can offer.

Fatimas mean true smoking comfort. Their smooth, well-balanced Turkish blend never disturbs—never irritates—never reminds you unpleasantly that you have been smoking, even though you may occasionally smoke more often than usual. Men appreciate this. And it is this common-sense comfort that makes Fatimas such a sensible cigarette and a constantly increasing favorite with men all over the United States.

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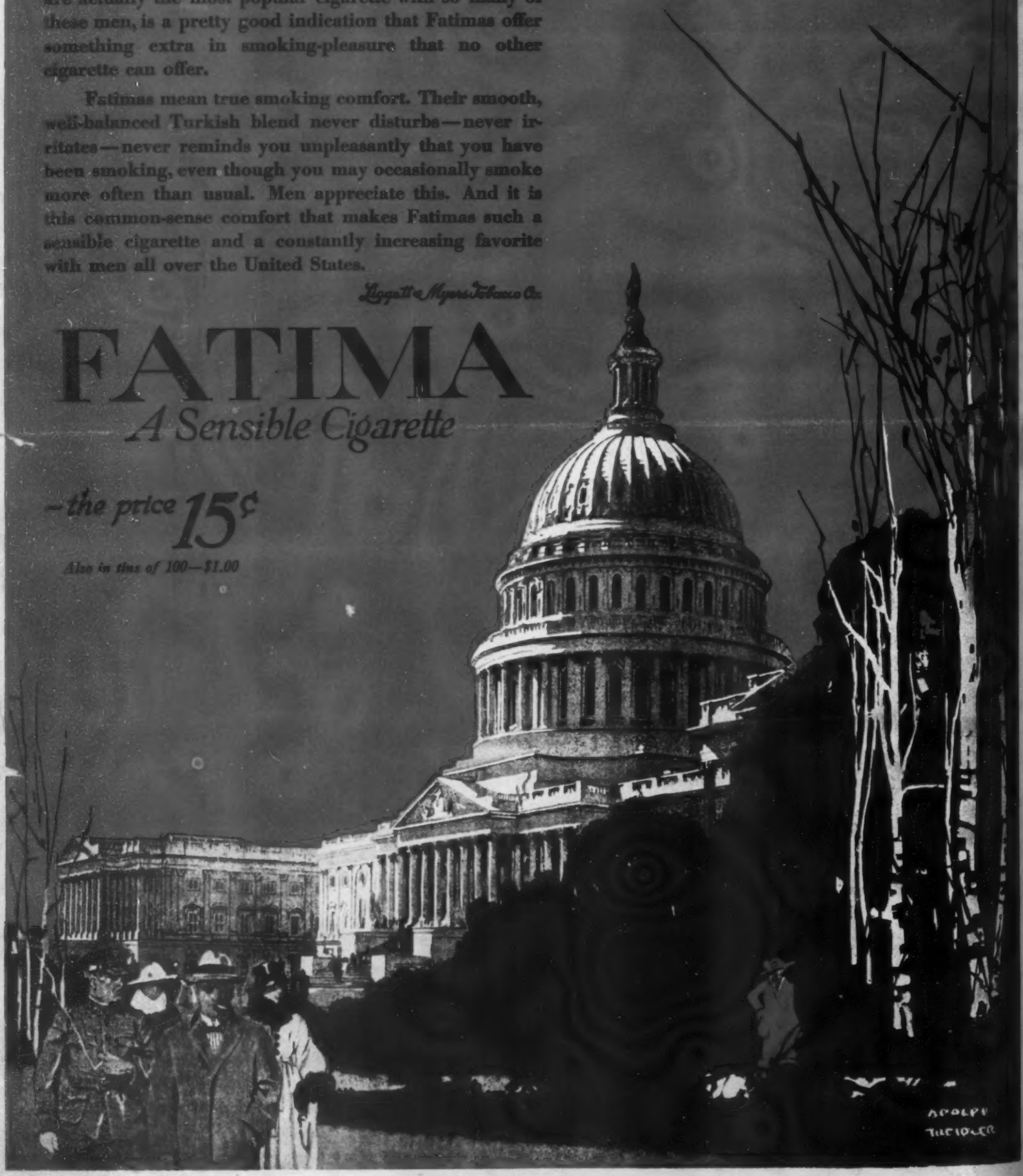

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SCIENTIFIC AMERICAN

BRAKING A LOAD OF LOGS DOWN A HILL ON THE END OF A CABLE [See page 145]

February 16, 1918

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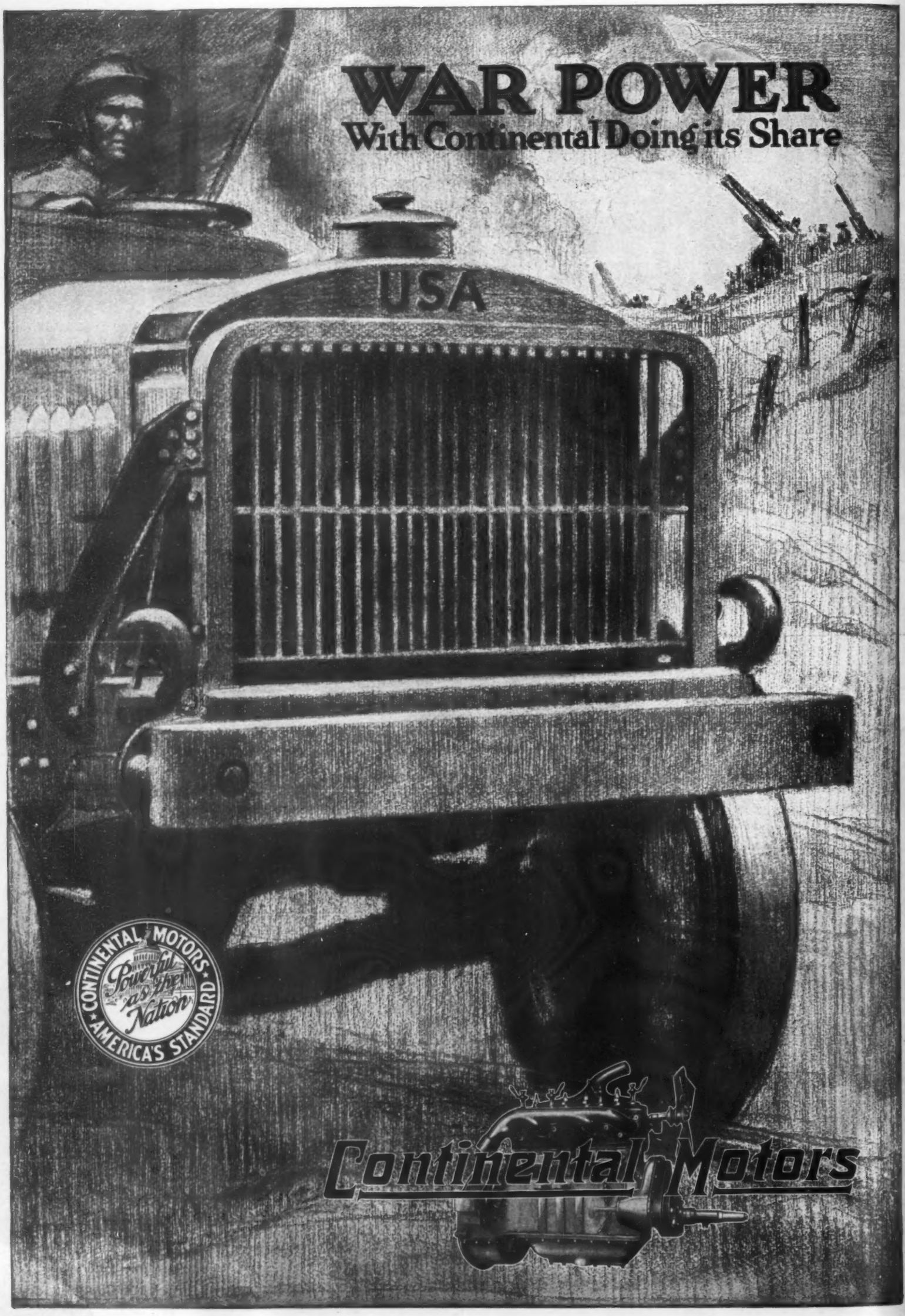
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